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CONTENTS OF VOLUME XXXV.

PAGE.
Title-page i
Officers and Trustees iii
Scientific Staff iv
Contents vii
Dates of Publication of Separata viii
List of Illustrations ix
List of New Names of Genera, Subgenera, Species, and Subspecies xv
Errata xix

ART. I.— Ants collected in British Guiana by the Expedition of the American Museum of Natural History during 1911. By WILLIAM MORTON WHEELER 1
II.— New and noteworthy Brazilian Muscoidea collected by Herbert H. Smith. By CHARLES H. T. TOWNSEND 15
III.— Four new Birds from the Belgian Congo. By JAMES P. CHAPIN. (Four text figures.) 23
IV.— Notes on American Subantarctic Cormorants. By ROBERT CUSHMAN MURPHY. (Thirteen text figures.) 31
V.— The Proper Generic Name of the Macaques. By J. A. ALLEN.. 49
VI.— Habits of *Aplodontia*. By H. E. ANTHONY. (Eight text figures.) 53
VII.— Two New Diving Petrels. By ROBERT CUSHMAN MURPHY and FRANCIS HARPER 65
VIII.— On a new race of Minnow from the Rocky Mountains Park. By JOHN TREADWELL NICHOLS 69
IX.— A new *Gymnachirus* from North Carolina. By JOHN TREADWELL NICHOLS. (One text figure.) 71
X.— The Pennant-winged Nightjar of Africa and its Migration. By JAMES P. CHAPIN. (One text figure, one map.) 73
XI.— New South American Mammals. By J. A. ALLEN 83
XII.— The Neotropical Weasels. By J. A. ALLEN 89
XIII.— List of Mammals Collected for the American Museum in Ecuador by William B. Richardson, 1912–1913. By J. A. ALLEN 113
XIV.— The Lungfish Remains of the Coal Measures of Ohio, with special reference to the supposed Amphibian *Eurythorax* of Cope. By L. HUSSAKOF. (Seven text figures.) 127
XV.— A new Pycnodont Fish, *Cœlodus syriacus*, from the Cretaceous of Syria. By L. HUSSAKOF. (Two text figures.) 135
XVI.— Shore Fishes collected by the 'Albatross' Expedition in Lower California with descriptions of new species. By RAYMOND C. OSBURN and JOHN TREADWELL NICHOLS. (Fifteen text figures.) 139

PAGE.
XVII.— Some apparently undescribed Birds from the collection of the Roosevelt South American Expedition. By GEORGE K. CHERRIE 183
XVIII.— List of Mammals Collected in Colombia by the American Museum of Natural History Expeditions, 1910–1915. By J. A. ALLEN. (Map) 191
XIX.— Studies on the Evolution of the Primates. (Plate I, and thirty-seven text figures.) Part I. The Cope-Osborn Theory of Trituberculy and the Ancestral Molar Patterns of the Primates. Part II. Phylogeny of Recent and Extinct Anthropoids with special reference to the Origin of Man. By WILLIAM K. GREGORY 239
XX.— Panama Mammals collected in 1914–1915. By H. E. ANTHONY. (Five text figures, with map.) 357
XXI.— Parasitic Muscid Larvæ collected from the African Elephant and the White Rhinoceros by the Congo Expedition. By J. BEQUAERT. (Three text figures.) 377
XXII.— Two new Birds from Venezuela. By GEORGE K. CHERRIE 389
XXIII.— New Birds from the collection of the Collins-Day Expedition to South America. By GEORGE K. CHERRIE 391
XXIV.— Voyage of the 'Albatross' to the Gulf of California in 1911. By CHARLES HASKINS TOWNSEND. (Forty-five text figures and map.) 399
XXV.— A Marsupial from the Belly River Cretaceous. With critical observations upon the Affinities of the Cretaceous Mammals. By W. D. MATTHEW. (Plates II–VI, and four text figures.) . . 477
XXVI.— The Geographic Distribution of Bombidæ (Hymenoptera), with notes on certain species of Boreal America. By FRANK E. LUTZ. (Two text figures.) 501
XXVII.— New Mammals collected on the Roosevelt Brazilian Expedition. By J. A. ALLEN 523
XXVIII.— The Auditory Ossicles of *Aplodontia*. By T. D. A. COCKERELL. (Three text figures.) 531
XXIX.— On *Dysithamnus mentalis* and its Allies. By W. E. CLYDE TODD. (Four text figures.) 533
XXX.— Mammals collected on the Roosevelt Brazilian Expedition, with Field Notes by LEO E. MILLER. By J. A. ALLEN. (Six text figures.) 559
XXXI.— On the structure of the Brain-Case in certain Lower Permian Tetrapods. By D. M. S. WATSON. (Eleven text figures.) . . 611
XXXII.— Reconstructions of the Skulls of three Pelycosaurs in the American Museum of Natural History. By D. M. S. WATSON. (Seven text figures.) 637
XXXIII.— Natural History Notes on the Devilfish, *Manta birostris* (Walbaum) and *Mobula olfersi* (Müller). By RUSSELL J. COLES. (Five text figures.) 649
XXXIV.— Description of a new Amphisbænian collected by Dr. Charles S. Mead in 1911, on the Isle of Pines, Cuba. By MARY C. DICKERSON. (Two text figures.) 659

PAGE.

XXXV.— Shrews collected by the Congo Expedition of the American Museum. By N. HOLLISTER. (Plates VII–XI.) 663

XXXVI.— Descriptive catalogue of West Indian Cicindelinæ. By CHARLES W. LENG and ANDREW J. MUTCHLER. (Plate XII, and five text figures.) 681

XXXVII.— A new crested Trachodont Dinosaur *Prosaurolophus maximus*. By BARNUM BROWN. (Five text figures.) 701

XXXVIII.— *Corythosaurus casuarius:* Skeleton, Musculature and Epidermis. Second paper. By BARNUM BROWN. (Plates XIII–XXII.) 709

XXXIX.— Three new species of Evaniidæ. By CHARLES T. BRUES. (One text figure.) 717

XL.— Two new Oligocene Titanotheres. By HENRY FAIRFIELD OSBORN. (Two text figures.) 721

XLI.— Preliminary Diagnosis of an apparently New Family of Insectivores. By H. E. ANTHONY. (Plate XXIII.) 725

XLII.— New species of the Bee Genus *Andrena* in the American Museum of Natural History. By HENRY L. VIERECK 729

XLIII.— Skeletal adaptations of *Ornitholestes*, *Struthiomimus*, *Tyrannosaurus*. By HENRY FAIRFIELD OSBORN. (Plates XXIV–XXVII, and twenty-seven text figures.) 733

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"	XL,	Nov.	2,	1916.
"	XLI	"	16,	1916.
"	XLII	"	16,	1916.
"	XLIII,	Jan.	13,	1917.

LIST OF ILLUSTRATIONS.

Plates.

I.— Homologies of the molar cusps in Placentals and Marsupials.

II.— *Eodelphis browni*, type. Figs. 1–3, lower jaw, external, superior and internal views; Figs. 4, 4*a*, stereoscopic view of front of lower jaw.

III and IV.— *Eodelphis browni*, type. Zygomatic and temporal portions of skull, with corresponding views of the temporal region of *Didelphis virginiana* introduced for comparison. Fig. 1, *Eodelphis*, internal view of jugal showing small portion of maxillary attached; Figs. 2, 3, 4, *Eodelphis*, jugal and temporal regions, superior external and inferior views; 2*a*, 3*a*, 4*a*, corresponding views of temporal region of *Didelphis;* Fig. 5, *Eodelphis;* 5*a*, *Didelphis*, posterior views of temporal showing relative extent of mastoid exposure; Fig. 6, *Eodelphis*, lower jaw of type, posterior view, showing inflection of angle.

V and VI.— *Thlæodon padanicus*, type. Lower jaw and upper jaw fragment. Figs. 1, 2, 3, superior internal and external views of lower jaw; Figs. 4, 5, 6, external palatal and internal views of upper jaw.

VII.— Fig. 1, *Crocidura caliginea*, type; Fig. 2, *Crocidura oritis*, type; Fig. 3, *Crocidura latona*, type; Fig. 4, *Crocidura ludia*, type; Fig. 5, *Crocidura polia*, type; Fig. 6, *Crocidura congobelgica*; Fig. 7, *Sylvisorex oriundus*, type. Skulls, all nat. size.

VIII.— Figs. 1, 1*a*, *Crocidura caliginea*, type; Figs. 2, 2*a*, *Crocidura oritis*, type; Figs. 3, 3*a*, *Crocidura latona*, type. Dentition, $\frac{5}{1}$.

IX.— Figs. 1, 1*a*, *Crocidura ludia*, type; Figs. 2, 2*a*, *Crocidura polia*, type; Figs. 3, 3*a*, *Crocidura congobelgica*, type; Figs. 4, 4*a*, *Sylvisorex oriundus*, type. Dentition, $\frac{5}{1}$.

X.— Fig. 1, *Crocidura nyansæ kivu* Osgood; Fig. 2, *Crocidura jacksoni denti* Dollman. Animals.

XI.— Fig. 1, *Sylvisorex oriundus* Hollister; Fig. 2, *Scutisorex congicus* Thomas. Animals.

XII.— West Indian Cicindelinæ: 8 species, dorsal views.

XIII–XVII.— *Corythosaurus casuarius* Brown. Skeleton.

XVIII–XX.— *Corythosaurus casuarius* Brown. Details of skin characters.

XXI, XXII.— *Corythosaurus casuarius* Brown. Restorations.

XXIII.— *Nesophontes edithæ* Anthony. Skull.

XXIV.— Skeleton of *Struthiomimus altus* Osborn.

XXV.— Skeleton of *Tyrannosaurus rex* Osborn.

XXVI.— Reconstruction of skeletons of *Struthiomimus rex* and *Ornitholestes hermanni.*

XXVII.— Pelvic arcade and vertebral structure of *Tyrannosaurus rex.*

Text Figures.

	Page.
Stilbopsar leucothorax, male and female	25
Paludipasser uelensis, head and foot	26
Malimbus flavipes, head and foot	27

	PAGE.
Bradypterus carpalis, head, foot, wings and tail	28
Phalacrocorax georgianus, male and female, courting	35
“ “ male and female	41
“ “ egg and newly hatched young	42
“ “ pair at the nest	43
“ “ female brooding young	43
“ “ pair at the nest, the female brooding	44
“ “ female with young 49 days old	45
“ “ brooding female	45
“ “ two views of a shag standing on the brink of a cliff	46
Aplodontia, 8 figures, illustrating habits	60–63
Gymnachirus melas sp. nov	71
Pennant-winged Nightjar (*Cosmetornis vexillarius*)	74
Cosmetornis vexillarius, map showing seasonal distribution	76
Sagenodus, operculum	128
Ctenodus ohiensis, cranial plates	130
Sagenodus, scales	132
Sagenodus serratus, scales	132
Sagenodus?, cleithrum and rib	132
Cœlodus syriacus n. sp., type; right splenial dentition	135
“ “ diagram of the complete lower dentition	136
Raja microtrachys sp. nov	143
Urobatis concentricus sp. nov	145
Letharchus pacificus sp. nov	148
Bascanichthys bascanoides, sp. nov	148
Fundulus parvipinnis brevis subsp. nov	150
Thylosurus pterurus sp. nov	154
Siphostoma exile sp. nov	154
Atherinopsis sonoræ sp. nov	157
Amia guadalupensis sp. nov	161
Girella simplicidens sp. nov	166
Hermosilla robusta sp. nov	167
Callyodon microps sp. nov	170
Callyodon compressus sp. nov	172
Dactyloscopus cinctus sp. nov	176
Lucioblennius lucius sp. nov	179
Sketch-map of Southwestern Colombia showing localities visited by American Museum Expeditions (facing)	194
The Osbornian nomenclature of molar cusps	240
The Cope-Osborn hypothesis of the circumduction of the para- and metacones	241
Palæosyops leidyi, deciduous molars and first molar	245
Antechinomys laniger, upper teeth	246
Amphitherium prevostii, lower jaw	246
Didelphis sp., lower premolars and molars	247
Marmosa chapmani, deciduous molar and permanent teeth	247
Diagram illustrating progressive complication of the premolar-molar series in a generalized mammal	247
Interlocking relations of upper and lower premolars	251
Upper and lower premolars and molars of two primitive North American Eocene Primates	253

PAGE.
Interlocking relations of upper and lower cheekteeth........................ 254
Comparative series of m^2 in Hominidæ and Tertiary anthropods............ 255
Deciduous upper molars of Chimpanzee and Man........................ 255
" lower molars " " " "........................ 256
" last lower molar in Man, Chimpanzee, *Dryopithecus* and *Omomys* 256
Anthropoid heritage in lower molar pattern of Man........................ 257
Notharctus formosus, skull........................ 262
Upper and lower molar patterns of primitive Eocene lemuroids............ 263
Under side of skull in Lemuriformes and Tarsiiformes.................... 264
" " " " " Platyrrhinæ and Catarrhinæ........................ 265
" " " " " in a Gibbon and a Chimpanzee..................... 268
Side view of skulls of Gibbon and Chimpanzee........................ 269
Front view " " " " " "........................ 270
Top view " " " " " "........................ 271
Under side of skull in a female native Australian and a young Gorilla........ 278
Lower jaws and teeth of Parapithecidæ and Hylobatinæ.................. 282
" " side view " " " "................. 283
Third right molar of *Palæosimia rugosidens* and *Simia satyrus*.............. 286
Sivapithecus indicus and *Simia satyrus*, side view of lower jaw.............. 288
Sivapithecus and *Dryopithecus*, side views of lower jaw................... 289
Lower teeth of *Parapithecus*, *Propliopithecus*, *Pliopithecus*, *Dryopithecus*... 294
Third left lower molar of two species of *Dryopithecus*.................... 296
Second left lower molar of *D. punjabicus*, Orang and Gorilla............ 296
Upper cheek teeth of *D. punjabicus* and Gorilla........................ 297
Third right lower molar of *D. rhenanus*, *D. giganteus* and Chimpanzee...... 298
Upper teeth and palate of *Palæopithecus sivalensis*........................ 299
" " " " " *Pliopithecus antiquus* and *Hylobates lar*........ 302
Third left lower molar of *Dryopithecus rhenanus* and *D. darwini*............. 305
Left upper molars of *Griphopithecus suessi*, *Dryopithecus punjabicus*, and *D. rhenanus*........................ 309
Third lower molar of *Neopithecus brancoi* and *D. rhenanus*.................. 310
Right lower premolar-molar series of primitive men and anthropoids....... 312
Three views of m_1 figured by Nehring as a human tooth from the diluvium at Taubach, and crown of the corresponding tooth of a Chimpanzee....... 313
Piltdown lower jaw compared with jaw of a female Orang and a modern negro, outer side........................ 314
Same, inner side........................ 315
Same, from above........................ 317
Canine tooth of the Piltdown man compared with canines of female Orang... 318
Temporal bones of the Piltdown man, of a negro and of a female Orang...... 319
Third right upper molar of *Pithecanthropus* in comparison with various human and anthropoid types........................ 320
Comparison of upper molars of men and anthropoids........................ 324
Plantar aspect of foot of infant Gorilla and man (Australian black)........ 330
Geological succession and provisional phylogeny of the Hominidæ and Simiidæ........................ 337
Summit of Mt. Tacarcuna........................ 359
Rio Tuyra at El Real........................ 360
Rio Pirri at El Real........................ 361

PAGE.
Rio Pucro below Tapalisa 361
Cordillera near Tacarcuna 362
Map of Darien region ....(facing) 376
Gyrostigma pavesii, larva of the second stage 384
" " posterior stigmatic plates of second stage larva 386
" " puparium 387
The beam trawl of the 'Albatross' coming up with a load from deep water .. 404
Cañon at the northeast landing, Guadalupe Island, Lower California 406
Elephant Seals, Guadalupe Island 408
Old male Elephant Seal, Guadalupe Island 408
'Albatross' anchored between east and west San Benito Islands; century plants (*Agave*) in foreground 410
Petrel burrows, East San Benito Island 410
Cedros Island, barren southern end 411
" " watering place, southeast side 412
" " head of the central valley, showing the cedars from which the island derives its name 412
Elephant tree (*Pachycormus discolor*), San Bartolome Bay, Lower California 414
Seining party from the 'Albatross,' San Bartolome Bay, Lower California ... 414
Pattern of lobster pot used at San Bartolome Bay, Lower California 415
Abalone (*Haliotis*) used as bait for lobster pots, San Bartolome Bay, Lower California 416
Camp of lobster fishermen, San Bartolome Bay, Lower California 416
Cholla cactus (*Opuntia*), Cape St. Lucas, Lower California 419
Cardon cactus (*Pachycereus*), Cape St. Lucas, Lower California 419
Cape St. Lucas, Lower California 420
San José del Cabo, Lower California 421
View of Agua Verde Bay, Lower California 422
A fenced-in water hole, Agua Verde Bay, Lower California 422
Salt Lake at Carmen Island 423
Salt heaps at Carmen Island, showing salt as dug from surface of lake 423
Salt Lake at Carmen Island; salt digger at work 424
Giant cactus (*Pachycereus*) in bloom, Santa Catalina Island, Gulf of California 427
Valley at south end of Tiburon Island, Gulf of California 428
The 'Albatross' at Santa Catalina Island, Gulf of California; Viznaga cactus (*Echinocactus diguetii*) 12 feet high 429
Espiritu Santo Island, Gulf of California; general view of station for cultivation of the pearl oyster 435
Thatched roofs over the cross-sections of the canal; the open Bay on the right 435
Shallow trays on which young pearl oysters are laid for growth 437
A spat collector landed, with a full setting of young shells 437
Nearer view of the spat collector 439
Wooden trays of the spat collector removed and young oysters being placed on small wire trays for growth 439
Cemented grades on the beach to facilitate the handling of spat collectors and other oyster growing apparatus 440
Cleaning and packing shells of artificially-grown pearl oysters 440
Shelter and apparatus 441

PAGE.
Wooden apparatus for the protection of pearl oysters laid out for growth 441
Forms of wire apparatus for the protection and handling of pearl oysters laid out for growth 442
Photographs of pearl oysters (*Margaratifera* var. *mazatlantica*) showing newly formed pearls which have developed on various parts of the mantle 443
Oyster reefs at low tide, Algodones Lagoon, Gulf of California 446
Seal Rock near San Josef Island, Gulf of California, showing numerous shells of green turtle left on the beach by fishermen 446
Natural oyster beds at low tide, Algodones Lagoon, above mouth of Yaqui River, Gulf of California 448
California Sea Lion (*Zalophus californianus*), San Luis Islands, near head of the Gulf of California 449
Fishes from Santa Cruz Island, Gulf of California 450
Giant Weakfish (*Cynoscion macdonaldi*) 451
Map of the Lower California region, showing route of the 'Albatross' Expedition in 1911 (facing) 476
Eodelphis browni, lower jaw of type, external view and crown view of teeth 486
“ “ fragments of skull of type, side and under views 489
Thlæodon padanicus, upper jaw fragment, lower jaw and crown view of lower teeth 493
Didelphis virginiana, skull and lower jaw, the cross-hatching showing the parts preserved in *Eodelphis browni* type 497
Bombus, distribution in America 508
Pratorum, suggested phylogeny of a portion of the group and the distribution of the species 518
Aplodontia pacifica, malleus, two views 532
“ “ incus 532
“ “ stapes. *A,* from above. *B,* from the side 532
Dysithamnus mentalis mentalis, map of distribution 538
“ “ map of distribution of subspecies 544
“ *extremus,* map of distribution 550
“ *semicinereus* map of distribution 550
“ *andrei* and *D. affinis,* map of distribution 553
Panthera paraguensis, views of audital bulla from 6 skulls 577
Eryops sp., brain-case, in median section 612
“ “ “ lateral aspect 613
“ “ “ 615
“ stapes 617
Diadectes, posterior part of the brain-case, lateral aspect 620
“ “ “ “ “ “ in median section 621
“ the bony labyrinth 622
Captorhinus sp., occipital view of skull 623
Diopeus leptocephalus, occipital view of the type skull 626
“ “ brain-case of the type specimen 627
“ “ brain-case of the type specimen in sagittal section 628
Edaphosaurus pogonias, reconstruction of type skull, dorsal aspect 638
“ “ “ “ “ “ lateral aspect 639
“ “ “ “ “ “ palate 640
“ “ “ “ “ “ occiput 641

PAGE.
Diopeus leptocephalus, reconstruction of the posterior part of the type specimen 642
Theropleura, reconstruction of posterior part of skull, dorsal aspect 644
“ reconstruction of posterior part of skull, lateral aspect 644
Manta, side view 650
“ front view 651
Mobula, dorsal view 652
“ ventral view 653
Manta, diagram illustrating birth of young 656
Cadea palirostrata sp. nov., dorsal, ventral and side view of head of type 660
“ “ “ “ ventral posterior of body to show number of anal segments and præanal pores 661
Vicinity of Everglade, Fla 668
Alkali flat at Santa Rita, Porto Rico 691
Beach at Samana Bay, Santo Domingo 693
Baños San Vincente, Cuba 695
Locality 12½ kilometers south of Piñar del Rio, Cuba, on the road to Coloma 697
Prosaurolophus maximus, side view of reconstructed skull 702
“ “ dorsal view of reconstructed skull 706
“ “ type skull, side view 706
Saurolophus osborni, top view of reconstructed skull 705
Evania rubrofasciata sp. nov., wing 718
Allops walcotti sp. nov., type skull 722
Megacerops riggsi sp. nov., type jaw 723
Ornitholestes hermanni, reconstructed skull 734
“ “ incomplete manus 736
“ “ manus, restored 737
Struthiomimus altus, manus 737
Ornithomimus velox, left pes 739
Struthiomimus altus, left pes 739
“ “ restoration of skeleton 742
Struthiomimus and *Struthio*, skulls 746
Struthiomimus altus, abdominal ribs 747
“ “ humerus 748
Cholœpus didactylus, humerus 748
Struthiomimus altus, fore and hind limb bones 749
Bradypus tridactylus, skeleton 750
Cholœpus didactylus, manus 751
Struthiomimus altus, left pes 752
Physignathus lesuerii, running pose 753
Chlamydosaurus, running pose 753
Struthiomimus altus, suggested running pose 755
“ “ suggested tree-browsing pose 756
“ “ suggested shore-living pose 756
“ “ suggested running pose 760
Tyrannosaurus and *Struthiomimus*, mounted skeletons 761
Manospondylus gigas, vertebral centrum 762
Tyrannosaurus rex, mounted skeleton, anterior and lateral views 764
“ “ sacro-pelvic arcade 766
“ “ sacro-iliac arcade 768
“ “ humerus and femur 769

LIST OF HIGHER GROUPS, GENERA, SUBGENERA, SPECIES, AND SUBSPECIES DESCRIBED OR RENAMED IN THIS VOLUME.

Higher Groups.

	Page
Nesophontidæ Anthony	728

Genera and Subgenera.

Atactomima Townsend	15
Frontocnephalia Townsend	16
Beskiocephala Townsend	17
Formicomyia Townsend	17
Microgymnomma Townsend	18
Chrysometopiops Townsend	19
Chrysosturmia Townsend	20
Macrojurinia Townsend	20
Cylindrophasia Townsend	22
Eodelphis Matthew	482
Prosaurolophus Brown	701
Nesophontes Anthony	725
Struthiomimus Osborn	744

Species and Subspecies.

Pheidole cramptoni Wheeler	4
“ *mimula* Wheeler	5
“ *cataractæ* Wheeler	6
Wasmannia subpolita Wheeler	8
Sericomyrmex lutzi Wheeler	9
Dendromyrmex fabricii var. *rufescens* Wheeler	13
“ *nidulans* var. *nigripes* Wheeler	13
“ *chartifex* var. *felis* Wheeler	13
Euloewia ochreicornis Townsend	15
Atactomima crescentis Townsend	16
Frontocnephalia angusta Townsend	16
Beskiocephala flava Townsend	17
Formicomyia ovata Townsend	18
Microgymnomma orbitalis Townsend	18
Chrysometopiops smithii Townsend	19
Chrysosturmia orbitalis Townsend	20
Chrysoexorista viridis angustifrons Townsend	21

	PAGE.
Macromeigenia aurea Townsend	21
Stilbopsar leucothorax Chapin	23
Paludipasser uelensis Chapin	24
Malimbus flavipes Chapin	27
Bradypterus carpalis Chapin	27
Pelecanoides urinatrix chathamensis Murphy and Harper	65
" *georgica* Murphy and Harper	66
Rhinichthys cataractæ smithi Nichols	69
Gymnachirus melas Nichols	71
Metachirus nudicaudatus antioquiæ Allen	83
Tamandua tetradactyla punensis Allen	83
Sylvilagus boyleyi Allen	84
Cavia (Cavia) anolaimæ Allen	85
Oryzomys barbacoas Allen	85
Glossophaga apolinari Allen	86
Saimiri caquetensis Allen	87
Mustela tropicalis nicaraguæ Allen	100
Cœlodus syriacus Hussakof	135
Raja microtrachys Osburn and Nichols	142
Urobatis concentricus Osburn and Nichols	144
Letharchus pacificus Osburn and Nichols	146
Bascanichthys bascanoides Osburn and Nichols	147
Fundulus parvipinnis brevis Osburn and Nichols	150
Tylosurus pterurus Osburn and Nichols	152
Siphostoma exile Osburn and Nichols	153
Atherinopsis sonoræ Osburn and Nichols	156
Amia guadalupensis Osburn and Nichols	160
Girella simplicidens Osburn and Nichols	165
Hermosilla robusta Osburn and Nichols	166
Callyodon microps Osburn and Nichols	170
" *compressus* Osburn and Nichols	171
Dactyloscopus cinctus Osburn and Nichols	176
Lucioblennius lucius Osburn and Nichols	179
Chætura chapmani viridipennis Cherrie	183
Celeus roosevelti Cherrie	183
Myrmotherula kermiti Cherrie	184
Rhopoterpe torquata tragicus Cherrie	184
Synallaxis rufogularis Cherrie	185
Phacellodomus ruber rubicula Cherrie	186
Philydor erythrocercus lyra Cherrie	186
Xiphocolaptes major saturatus Cherrie	187
Picolaptes angustirostris prædatus Cherrie	187
Myiopagis viridicata rondoni Cherrie	188
Sporophila hypoleuca clara Cherrie	188
Myospiza manimbe nigrostriata Cherrie	189
Thraupis palmarum duvida Cherrie	190
Notharctus formosus Gregory	262
Tylomys fulviventer Anthony	366
Hemithraupis flavicollis aurigularis Cherrie	389

	PAGE.
Argicus macrodactylus caurensis Cherrie	389
Taraba major virgultorum Cherrie	391
Xiphorhynchus guttata rimarum Cherrie	391
Capito auratus insperatus Cherrie	391
Piaya rutila chaparensis Cherrie	392
“ “ *orinocensis* Cherrie	393
Capito dayi Cherrie	394
Crocomorphus flavus inornatus Cherrie	395
Hypocnemis collinsi Cherrie	395
Drymophila phantatis Cherrie	396
Formicivora rufa chapmani Cherrie	396
Eodelphis browni Matthew	482
Præchimys boimensis Allen	523
Œcomys milleri Allen	523
“ *florenciæ* Allen	524
“ *emiliæ* Allen	525
Oryzomys (Oligoryzomys) microtis Allen	525
“ “ *utiaritensis* Allen	527
“ “ *mattogrossæ* Allen	528
Zygodontomys tapirapoanus Allen	528
Molossus cherriei Allen	529
“ *daulensis* Allen	530
Dysithamnus mentalis æquatorialis Todd	539
“ “ *lateralis* Todd	540
“ *extremus* Todd	549
Tapirus terrestris guianæ Allen	566
Cadea palirostrata Dickerson	659
Crocidura caliginea Hollister	664
“ *oritis* Hollister	666
“ *latona* Hollister	667
“ *ludia* Hollister	668
“ *polia* Hollister	669
“ *congobelgica* Hollister	670
Sylvisorex oriundus Hollister	672
Tetracha sobrina var. *antiguana* Leng and Mutchler	686
“ *carolina* var. *floridana* Leng and Mutchler	688
Cicindela cardini Leng and Mutchler	690
“ *cubana* Leng and Mutchler	696
Prosaurolophus maximus Brown	701
Evania carinata Brues	717
“ *rubrofasciata* Brues	718
Chalcidopterella manni Brues	719
Allops walcotti Osborn	721
Megacerops riggsi Osborn	723
Nesophontes edithæ Anthony	725
Andrena (Andrena) beutenmuelleri Viereck	729
“ “ *discolor* Viereck	730
“ “ *edwardsi* Viereck	731
“ “ *idahorum* Viereck	732

ERRATA.

Page 143, Fig. 1, for *microslachys* read *microtrachys*.
“ 248, lines 12 and 13 from bottom, for *Didelpys* read *Didelphis*.
“ 251, paragraph 2, first line, for *Didelphys* read *Didelphis*.
“ 395, line 9 from top, for **inornata** read **inornatus**.
“ 566, bottom line, for **guianiæ** read **guianæ**.
“ 682, line 3 from bottom, for Columbia read Colombia.
“ “ “ “ “ “ “ Equador read Ecuador.
“ “ bottom line, for Equador read Ecuador.

BULLETIN

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AMERICAN MUSEUM OF NATURAL HISTORY.

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Article I.— ANTS COLLECTED IN BRITISH GUIANA BY THE EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY DURING 1911.[1]

By William Morton Wheeler.

Within recent years the majority of ants described from South America have come from Brazil, Paraguay, Argentina and Colombia, and comparatively little material has found its way into collections from the Guianas, which furnished the early naturalists with so many specimens. This is, of course, explained by the large number of resident and visiting collectors who have been recently working in other parts of South America, especially in Brazil and Argentina. I was glad, therefore, to have an opportunity to study the ants collected during 1911 in British Guiana by Dr. H. E. Crampton and Dr. F. E. Lutz of the American Museum of Natural History. The course of the expedition was from Georgetown through Rockstone, Tumatumari, Kangaruma, Tukeit, Kaieteur, Chenapown, Saveritik, Parmak to Kamawa-wong (Roraima) and return by the same route. The collection contains several new and interesting species, though the greater number are well known. This was to be expected, because so many members of the neotropical ant-fauna have a very wide distribution, not only in northern South America but also in Central America and tropical Mexico.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 105.

Family FORMICIDÆ.

Subfamily PONERINÆ.

1. **Paraponera clavata** *Fabr.* Several workers taken at Tukeit and Kaieteur on the forest floor (Lutz) and one from near the Wailang River (Crampton).

2. **Ectatomma tuberculatum** *Olivier.* Numerous workers from Kaieteur and Tumatumari; at Kaieteur they were most numerous in the forest where it meets the savannah (Lutz); also workers from near the Karanang River (Crampton).

3. **Ectatomma quadridens** *Fabr.* Numerous workers from Georgetown and Kaieteur (Crampton and Lutz) and from the former locality (J. J. Welsh).

4. **Ectatomma strigosum** *Emery* var. **lugens** *Emery.* A single worker from Kaieteur (Lutz) agreeing well with Emery's description.

5. **Ectatomma** (**Gnamptogenys**) **mordax** *F. Smith.* Numerous workers and one winged female from Kaieteur (Lutz).

6. **Ectatomma** (**Gnamptogenys**) **tortuolosum** *F. Smith.* Workers from Rockstone (Lutz).

7. **Neoponera villosa** *F. Smith* subsp. **inversa** *F. Smith.* Three workers from Kaieteur (Lutz).

8. **Neoponera apicalis** *Latr.* Two workers from Tukeit and one from Kaieteur (Lutz).

9. **Neoponera obscuricornis** *Emery.* A single worker from Kaieteur (Lutz), attached to a leaf and with a fungus (*Cordyceps unilateralis* Tul.) growing out of the back of its head.

10. **Neoponera unidentata** *Mayr.* Two workers from Kaieteur (Lutz).

11. **Neoponera carinulata** *Roger.* A single worker from Tukeit (Lutz).

12. **Neoponera commutata** *Roger.* Several workers and a partially deälated female from Kaieteur, Potaro Landing and Tukeit (Lutz). The specimen from Tukeit is accompanied by a large termite worker labelled " this ant's prey."

13. **Pachycondyla crassinoda** *Latr.* Seven workers from Kaieteur and Tukeit (Crampton and Lutz).

14. **Euponera** (**Mesoponera**) **lævigata** *F. Smith.* A single worker from Kaieteur (Lutz).

15. **Euponera (Mesoponera) constricta** *Mayr.* Several workers from Kaieteur and Tukeit (Crampton and Lutz).

16. **Euponera (Trachymesopus) stigma** *Fabr.* Specimens of all three phases from Kaieteur and Tukeit (Lutz).

17. **Ponera opaciceps** *Mayr.* Five workers from Kaieteur and a deälated female from Tukeit (Lutz).

18. **Anochetus mayri** *Emery.* A single worker from Tukeit (Lutz).

19. **Anochetus (Stenomyrmex) emarginatus** *Fabr.* Two workers of the typical form of the species from Rockstone and Tumatumari (Lutz).

20. **Odontomachus chelifer** *Latr.* Two workers taken in the forest near Tururaparu — a small creek west of Chenapown (Crampton).

21. **Odontomachus hastatus** *Fabr.* A worker and female taken at Kaieteur (Lutz).

22. **Odontomachus hæmatoda** *L.* A worker and deälated female from Kaieteur (Lutz).

Subfamily Dorylinæ.

23. **Eciton burchelli** *Westwood.* Numerous workers from Parmak, Brazil. They were part of an "army" on the move in a large area of forest surrounded by savannah, five miles west of the Cotinga River, 3° north latitude; altitude, 2800 feet (Crampton).

Subfamily Myrmicinæ.

24. **Pseudomyrma gracilis** *Fabr.* Half a dozen workers of the typical form of this species from Georgetown, Rockstone and Kaieteur, B. G. and New Amsterdam, Paramaribo, D. G. (Lutz).

25. **Pseudomyrma gracilis** *Fabr.* var. **dimidiata** *Roger.* A deälated female from Tumatumari B. G. and a worker from New Amsterdam, D. G. (Lutz).

26. **Pseudomyrma nigrocincta** *Emery.* A single small deälated female from Kaieteur (Lutz).

27. **Solenopsis geminata** *Fabr.* A single small worker from Tumatumari.

28. **Solenopsis geminata** *Fabr.* subsp. **sævissima** *F. Smith.* Three workers from Georgetown (Crampton).

29. **Solenopsis brevicornis** *Emery.* A single worker from Tumatumari (Lutz).

30. **Pheidole cramptoni** sp. nov.

Soldier. Length 3–3.5 mm.

Allied to *Ph. subarmata* Mayr and *cornutula* Emery. Head rather flat, subrectangular, about $\frac{1}{5}$ longer than broad, slightly broader in front than behind, with deeply and acutely excised occipital border, nearly straight, subparallel sides and very prominent anterior corners. Occipital groove deep and narrow. Gular teeth very prominent and rather pointed. Eyes small, situated a little less than $\frac{1}{4}$ the distance from the anterior to the posterior corners of the head. Mandibles very convex, with two apical teeth. Clypeus very short, flattened, but with a short, prominent carina behind, the anterior border nearly straight. Frontal area impressed, subtriangular, without a median carinula. Frontal carinæ short, each anteriorly forming a prominent, suberect, tooth-like lobe, diverging behind to form the indistinct mesial borders of very shallow scrobe-like impressions for the antennæ. Antennæ short and slender; scapes reaching to the middle of the head; funicular joints 2–7 broader than long, club scarcely longer than the remainder of the funiculus, its two basal joints of subequal length and only a little longer than broad. Thorax small, through the humeri about half as broad as the head; pro- and mesonotum forming a single mass, transversely flattened dorsally between the humeri which are prominent and bluntly angular; in profile the mesonotum is convex, without a torus behind, marginate on the sides and falling rather abruptly to the pronounced mesoëpinotal constriction. Epinotum small, much narrower and lower than the promesonotum; its base and declivity subequal in profile, sloping between the spines, which are rather stout, moderately long and acute, nearly as long as the base of the epinotum, longer than broad at their bases, but shorter than their distance apart, directed upward, outward and backward. Petiole from above violin-shaped, a little more than twice as long as broad, broader behind than in front, the node rather low, compressed anteroposteriorly, with transverse, broadly excised superior border. Postpetiole only a little broader than the petiole, subrectangular from above, a little broader in front than behind and only slightly broader than long. Gaster as large as the head, elongate elliptical, with straight anterior border. Femora strongly swollen in the middle.

Smooth and shining: mandibles very sparsely punctate. Anterior $\frac{3}{4}$ of head sharply but not densely, longitudinally rugose, with feeble indications of interrugal reticulation, posterior corners of head with very sparse and rather coarse, piligerous punctures. Epinotum and sides of petiole and postpetiole rather indistinctly and irregularly rugose. Gaster and legs with very fine, sparse, piligerous punctures.

Hairs pale yellow, rather fine but uneven, moderately long, suberect on the body, legs and antennal scapes.

Chestnut brown; antennæ and tibiæ paler; tarsi, mandibles and anterior $\frac{2}{3}$ of head pale brownish yellow; borders of mandibles, frontal carinæ, clypeal border and a spot on the clypeal carina, dark brown.

Worker. Length about 2 mm.

Head, excluding the mandibles, a little longer than broad, subelliptical; eyes prominent, just in front of the middle of its sides. Mandibles with several small subequal teeth. Clypeus with straight anterior border, rather convex, ecarinate. Antennal scapes reaching a little beyond the posterior corners of the head. Thorax similar to that of the soldier, but without prominent, angular humeri and the base of the epinotum longer in proportion to the declivity, the spines well-developed, but more slender, nearly as long as their distance apart at the base. Petiole slender, more than 3 times as long as broad, with small, rounded, entire node. Postpetiole half again as broad as the petiole, a little longer than broad, subglobular. Gaster with very straight, transverse anterior border.

Sculpture and pilosity very similar to those of the soldier, but the head not rugose in front, except at the extreme anterior corners, and the rugosity of the epinotum, petiole and postpetiole very feeble.

Chestnut brown; antennæ, mandibles, clypeus and legs paler and more yellowish.

Described from 10 soldiers and 12 workers taken at Kaieteur (Lutz).

This species is closely related to *Ph. subarmata* and *cornutula*, being about midway between the two in the shape of the head and frontal carinæ of the soldier, but the thorax is very different, as neither of the species mentioned has prominent, angular humeri or such a small postpetiole. The worker of *cramptoni* has prominent epinotal spines, which are lacking in *subarmata* and *cornutula* and the thorax is more robust and has the promesonotum transversely flattened above.

31. **Pheidole biconstricta** *Mayr.* Numerous soldiers and workers from Tukeit (Crampton and Lutz).

32. **Pheidole jelskii** *Mayr.* Numerous soldiers and workers from Rockstone (Lutz).

33. **Pheidole exigua** *Mayr.* Soldiers and workers from Tukeit and Kaieteur (Lutz).

34. **Pheidole mimula** sp. nov.

Soldier. Length 2.3 mm.

Related to *Ph. punctatissima* Mayr and *anastasii* Emery. Head very large, a little longer than broad, slightly narrower in front than behind, with deeply excised posterior border, feebly convex sides and rounded posterior corners, without traces of scrobes on the sides. Occipital groove moderately deep; eyes rather large and convex, elliptical, situated $\frac{1}{4}$ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two apical teeth. Clypeus short, rather flat, ecarinate, its anterior margin very feebly bidentate and scarcely excised in the middle. Frontal area distinct, impressed, subtriangular. Frontal carinæ very short. Antennæ rather long and slender, the scapes reaching to nearly $\frac{3}{4}$ the distance between the eyes and the posterior corners of the head; joints 2–8 of the funiculi as long as broad; two basal joints of club each more than twice as long as broad and together equalling the terminal joint. Thorax small, through the pronotum less than half as broad as the head. There is a distinct transverse line-like impression between the pro- and mesonotum and another broader one across the mesonotum, so that the thorax resembles that of *Ph. triconstricta* Mayr in profile. The humeri are neither angular nor prominent, the posterior portion of the mesonotum falls as an abrupt declivity to the mesoëpinotal constriction. Epinotum small, much lower than the promesonotum, with subequal base and declivity, the former feebly convex in profile, the latter concave. Spines slender, pointed, about half as long as the base of the epinotum, directed upward, backward and slightly outward; between them the surface of the epinotum forms a gradual, uninterrupted slope. Petiole about twice as long as broad, broadest behind through the node which is rounded and subconical, not compressed. Postpetiole broader than the petiole, somewhat broader than long, its sides bluntly but distinctly angular just in front of the middle. Gaster much smaller than the head, elliptical, with rounded anterior border. Legs rather long, femora incrassated in the middle.

Mandibles smooth and shining, very sparsely punctate. Clypeus, head, thorax, pedicel and basal $\frac{3}{4}$ of first gastric segment opaque. Clypeus obscurely punctate-rugulose. Head, thorax, pedicel and anterior portion of first gastric segment very finely and densely punctate; head also feebly longitudinally rugulose on the front and cheeks; its posterior corners with a few shallow, elongate foveolæ. Posterior fourth of first gastric segment and all the remaining segments shining. Legs subopaque.

Hairs yellow; on the head, thorax and gaster sparse, erect and blunt. Appendages with very fine pale pubescence, without erect hairs.

Testaceous; head slightly darker and more reddish; inner borders of mandibles and anterior border of clypeus and head dark brown or blackish.

Described from two specimens taken at Tukeit (Lutz).

This species belongs to a very complex and difficult group and seems to be most closely related to *Ph. punctatissima* and *anastasii*, but differs from both in its smaller size, much longer antennæ, very differently shaped promesonotum, narrower and less distinctly conulate postpetiole and peculiar pilosity, the hairs being blunt on the body, instead of pointed, and absent on the scapes and legs.

35. **Pheidole cataractæ** sp. nov.

Soldier. Length: 2.5 mm.

Related to *Ph. dimidiata* Emery and *orbica* Forel. Head large, as broad as long, a little broader behind than in front, with straight sides, broadly rounded posterior corners and deep occipital excision extending forward into a deep and rather broad occipital groove. Teeth on the anterior border of the gula large and projecting. Eyes moderately large and convex, situated a little less than $\frac{1}{3}$ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two apical teeth and two basal denticles. Clypeus short, flat, ecarinate, the anterior border with a small but distinct median excision, sinuate on the sides. Frontal area large, impressed, semicircular. Frontal carinæ diverging behind, continued back to the posterior third of the head as a ruga forming on each side the mesial border of a very faint, narrow scrobe-like impression. Antennæ rather slender; scapes reaching fully $\frac{3}{5}$ the distance between the eyes and posterior corners of the head, funicular joints 2–7 as long as broad; the two basal joints of the club subequal, fully twice as long as broad, together as long as the terminal joint. Thorax rather robust anteriorly through the humeri which are prominent but not angular. Promesonotal suture distinct and impressed; base of mesonotum convex, sloping rather gradually behind to the deep mesoëpinotal constriction. Epinotum in profile with straight base and concave declivity, the former distinctly longer than the latter; spines slender, short and acute, shorter than their distance apart at the base, directed upward. Petiole slender, fully 3 times as long as broad, slightly broader behind through the node, with straight sides, the node rather low, scarcely compressed anteroposteriorly, with straight, entire superior border. Postpetiole small, a little broader than the petiole and as long as broad, trapezoidal, broadest through the anterior border, with distinct anterior corners. Gaster much smaller than the head, elliptical, with rounded anterior border. Legs rather long; femora distinctly enlarged in the middle.

Smooth and shining; mandibles coarsely and sparsely punctate, coarsely rugose at the base. Clypeus smooth in the middle, longitudinally rugulose on the sides. Anterior $\frac{3}{5}$ of head sharply but not very densely, longitudinally rugose, the interrugal spaces more or less reticulate-punctate; posterior portion of head glabrous, with sparse piligerous punctures. Pronotum smooth and shining; meso- and epinotum subopaque, densely and uniformly punctate. Gaster and nodes of petiole and postpetiole smooth and shining, peduncle of petiole densely punctate.

Hairs whitish, very long, rather abundant but uneven, suberect both on the body and appendages and as long on the scapes and legs as on the thorax and gaster.

Black; antennæ castaneous; legs slightly paler, tarsi yellowish; mandibles, except their borders, clypeus and cheeks deep brownish red.

Worker. Length 2 mm.

Head a little longer than broad, regularly elliptical, without posterior corners, evenly and convexly narrowed behind to the occipital articulation which is distinctly marginate. Eyes in front of the middle of the sides. Mandibles with numerous small but very unequal denticles, apical tooth not enlarged nor lengthened. Clypeus convex, with rounded, slightly projecting anterior border. Antennæ long and slender, the scapes extending about $\frac{1}{4}$ of their length beyond the occipital border of the head. Thorax similar to that of the soldier, but more slender and the epinotum without spines, each of which is represented merely by the angle between the base and declivity in profile. Petiole and postpetiole also similar to those of the worker but the latter small and globular, scarcely broader than the petiole. Gaster smaller than the head. Legs slender.

Smooth and shining; mandibles sparsely punctate; mesonotum and epinotum densely punctate and subopaque.

Hairs whitish, suberect, abundant and conspicuously long, as long on the appendages as on the body; even the funiculi, excluding the clubs, bear long and conspicuous hairs.

Black or very dark brown; antennæ, and legs paler brown; mandibles and tarsi yellowish.

Described from three soldiers and five workers taken at Kaieteur (Lutz).

This species is evidently related to *Ph. dimidiata* and *orbica,* but is easily distinguished from both in the soldier phase by the much longer antennæ, more slender and upwardly directed epinotal spines, much longer and narrower petiole, longer hairs, etc. The worker of *cataractæ* has a very different head, lacking the posterior corners, the antennæ and legs are much longer than in *dimidiata* and *orbica* and the pilosity is much longer and more abundant, especially on the appendages.

36. **Monomorium pharaonis** *L.* Several workers taken on board the steamship "Korona" (Lutz).

37. **Wasmannia auropunctata** *Roger.* Numerous workers and a single winged female from Tukeit (Lutz and Crampton).

38. **Wasmannia subpolita** sp. nov.

Worker. Length: 2–2.2 mm.

Head as broad as long, distinctly broader behind than in front, with very feebly concave posterior border and rather convex sides; the posterior orbits of the rather large eyes at the median transverse diameter of the head. Mandibles with oblique terminal borders, armed with four subequal teeth. Clypeus large, convex, with evenly rounded, entire, projecting anterior margin. Frontal area small, crescentic. Frontal carinæ diverging behind, continued nearly to the posterior corners of the head, distinct in front but very feeble and more or less obsolete behind, forming the mesial borders of shallow, indistinct antennal scrobes. The lateral border of each scrobe is formed by a delicate ridge running just above the eye and also growing very faint posteriorly. Antennal scapes reaching to the posterior corners of the head; club of funiculus distinctly 3-jointed, its basal joint nearly as long as the second, but more slender; both together shorter than the enlarged terminal joint; first funicular joint fully 3 times as long as broad; second and seventh joints as long as broad; joints 3–6 a little broader than long. Thorax rather robust, but much narrower than the head, broadest through the pronotum, which is a little longer than broad, with rounded sides, flattened above and marginate along the raised border just back of the neck, the margination running down on each side to the insertion of the fore coxa. Mesoëpinotal constriction distinct; epinotum from above as broad as long, with inflated sides; in profile the base is convex in front, flattened behind, longer than the sloping, concave declivity. The spines are small and acute, as long as the distance between their bases, directed upward and outward and slightly backward. Petiole less than twice as long as broad, broadest behind through the rounded node, which rises rather abruptly from the peduncle; postpetiole rounded, a little broader than long and a little broader than the postpetiole, its node convex but lower than the petiolar node. Gaster about the size of the head, elongate elliptical, with rather straight anterior border.

Subopaque; delicately reticulate rugose; mandibles, clypeus, upper surface of head, nodes of petiole and postpetiole, gaster and appendages smooth and shining.

Hairs white, glistening; on the body very sparse, short, erect and slender but blunt at the tips, still shorter and oblique on the legs and scapes.

Honey yellow throughout, with only the mandibular teeth and articulations of the appendages brown and the eyes black.

Described from numerous workers taken at Tukeit and Kaieteur (Lutz) and Kauwa Creek, Roraima (Crampton).

This species at first sight may be readily mistaken for a *Leptothorax*, but it is evidently referable to the genus *Wasmannia*, though it exhibits many of the generic peculiarities in a feeble or obliterated condition. Among the described species it most closely approaches *W. iheringi* Forel of Brazil, but is very different in the shape of the thorax and in the peculiar and very feeble sculpture.

39. **Daceton armigerum** *Perty.* Several workers from Tukeit (Lutz) and a winged female from an unrecorded locality in British Guiana (R. W. Crew).

40. **Basiceros singularis** *F. Smith.* A worker from Tukeit and two workers and a deälated female from Kaieteur (Lutz). This seems to be the first time this extraordinary ant has been taken since the types were captured by Bates at Ega, Brazil. The specimens from British Guiana agree well with Smith's figures if due allowance be made for the inaccuracies that characterize all his illustrations.

41. **Sericomyrmex lutzi** sp. nov.

Worker. Length 3–3.5 mm.

Head cordate, narrowed in front, a little broader than long, the posterior corners prominent and angular but not acute, the posterior border angularly excised, the lateral borders feebly convex; scrobes for the antennæ distinct in front, not carried to the posterior corners but fading out about half way between them and the dilated frontal carinæ. Genal carinæ sharp, extending a little further back than the eyes. Eyes rather large, moderately convex; their posterior orbits about $\frac{1}{3}$ the distance between the anterior and posterior corners of the head. Mandibles rather long, their external borders concave in the middle, their terminal borders armed with 7 or 8 large teeth. Clypeus rather flat in the middle, its anterior border transverse, entire and nearly straight. Antennal scapes reaching to a little more than $\frac{2}{3}$ the distance between the eyes and the posterior corners of the head. Pronotum with three blunt tubercles, the median slightly larger than the others which form the lateral corners of the segment. Inferior pronotal angle with a flat, pointed tooth. Mesonotum with a pair of pointed, conical tubercles at its anterior corners, much larger than those on the pronotum, a little longer than broad at their bases, posteriorly with a pair of much smaller and blunter, approximated tubercles. Mesoëpinotal constriction short and pronounced. Epinotum short, as broad as long; the base with a pair of low blunt longitudinal ridges, in profile convex in front, sloping behind, very distinctly longer than the concave declivity. Petiole from above subrectangular, longer than broad, a little broader in front than behind, the node formed by a couple of small, blunt tubercles with rather straight anterior and concave posterior slopes in profile. Postpetiole about $1\frac{1}{2}$ times as broad as the petiole and nearly twice as broad as long, triangular in profile, its upper surface longitudinally impressed in the middle. First gastric segment subrectangular, a little longer than broad, with four blunt longitudinal ridges, two on the dorsal surface and one on each side forming the lateral borders. The latter are short and rather indistinct. Legs long and stout.

Mandibles shining, sparsely and coarsely punctate, with a few short, coarse striæ at the extreme base and near the terminal border. Remainder of body opaque. densely punctate-rugulose and covered with minute piligerous tubercles.

Covered, apart from the mandibles, with a dense layer of fine, grayish yellow hairs, partly forming a long, dense appressed pubescence and partly, on the dorsal surface of the body, funiculi and extensor surfaces of the legs, a sparser layer of longer, nearly reclinate and straight hairs.

Deep ferruginous red; legs scarcely paler; mandibles bright red, their terminal borders and the anterior border of the clypeus and head black.

Female. Length 5 mm.; wings 7 mm.

Differing from the worker in having the antennal scrobes more distinct behind, the mesonotum flattened above and without tubercles and the ridges on the first gastric segment longer and curved ventrally behind. Wings heavily infuscated; opaque, with dark brown veins.

Male. Length 4 mm.

Head, including the eyes, a little broader than long, narrowed behind, with straight, distinct posterior and postocular borders; cheeks short but distinct; eyes very large and convex; ocelli rather far apart. There are distinct but short scrobe-like depressions at the sides. Frontal carinæ short. Mandibles long and slender with three large apical and several small basal teeth. Antennæ slender, 12-jointed; scapes as long as the funiculi without their terminal joint; funiculi with a distinct 4-jointed club, the three basal joints of which are subequal and together longer than the terminal joint; first funicular joint nearly twice as long as broad, joints 2–7 distinctly longer than broad. Thorax rather robust, broader than the head, without tubercles; mesonotum without distinct Mayrian furrows; scutellum with a median longitudinal impression. Petiole from above broadest in the middle, the posterior lateral borders excised. Postpetiole similar to that of the worker. Gaster of the usual structure in male *Attini,* without longitudinal ridges on the first segment. Cerci distinct; genitalia very small and retracted. Legs slender.

Sculpture much as in the worker, but the mandibles less smooth and shining, very finely and densely striate. Gaster coarsely reticulate and sparsely punctate.

Both the pubescence and long, oblique hairs much less abundant than in the worker and female so that the surface of the integument is clearly visible. Legs and scapes with very fine, appressed pubescence, appearing naked under a low magnification.

Color more brownish than in the worker and female; head dark brown; antennæ, mandibles and legs brownish yellow. Wings colored as in the female.

Described from numerous workers and females and a single male from small "island" of forest in the savannah near Kauwa Creek, Roraima.

The relationship of this to the nine other known species of *Sericomyrmex* may best be shown by slightly modifying Forel's recent table for the workers and females of the genus and inserting the new form:

1. Pubescence woolly, whitish, resembling mold; erect or reclinate hairs absent. ♀ 5.7 mm. Brazil. . . . . *burchelli* Forel
   Suberect or reclinate hairs present, more or less abundant; aspect not moldy. . .2
2. Head with scrobes on each side for the accommodation of the antennæ. 3
   Scrobes absent. ☿ 4.5 mm. Brazil. . . . . *mayri* Forel
3. Scrobes complete and very distinct. 4
   Scrobes incomplete or partially indistinct. 5

4. First gastric segment not marginate on the sides; petiole unarmed. ☿ 3.5–3.8 mm. Brazil. . . . . *scrobifer* Forel
First gastric segment marginate on the sides, petiole bidentate ☿ 8 mm. Brazil. *opacus* Mayr
5. Mesonotum in front with a pair of elevated horns. 6
Mesonotum in front only with tubercles. 7
6. Epinotum bidentate; horns of mesonotum long and spiniform. ☿ 3.5–4 mm. Brazil. . . . . *saussurei* Emery
Epinotum unarmed; with two longitudinal ridges only; horns of mesonotum smaller, conical. ☿ 3–3.5 mm. ♀ 5 mm. British Guiana. . . . . *lutzi* sp. nov.
7. Pile of body and appendages reclinate or very oblique. Gaster scarcely marginate on the sides. ☿ 3.3–3.7 mm. Colombia. . . . . *diego* Forel
Pile suberect, first gastric segment anteriorly marginate on the sides. 8
8. Mesonotum bidentate behind. ☿ 2.7 mm. Brazil. . . . . *parvulus* Forel
Mesonotum obtusely bituberculate behind. Larger. 9
9. Scrobe very indistinct. ☿ 4.5 mm. Trinidad. . . . . *urichi* Forel
Scrobe rather distinct. ☿ 3.5 mm. Mexico. *aztecus* Forel

42. **Apterostigma mayri** *Forel.* Several workers from Tukeit (Lutz).

43. **Apterostigma urichi** *Forel,* var. A single worker from Kaieteur (Lutz) is considerably darker than typical specimens from Trinidad and covered with a bluish bloom. It may represent a new variety, but the material is not sufficient to justify the introduction of another name.

44. **Trachymyrmex farinosa** *Emery.* A single worker from Tukeit (Lutz).

45. **Trachymyrmex urichi** *Forel* subsp. **fuscus** *Emery,* var. Eight workers from the savannah 10 miles west of Parmak and the Cotinga River, altitude about 3000 ft. (Crampton). These agree closely with cotype specimens but are somewhat darker and covered with a whitish bloom.

46. **Acromyrmex emilii** *Forel.* Numerous workers from Kaieteur and Amatuk (Lutz).

47. **Atta sexdens** *L.* Workers of the typical form from Rockstone (Lutz).

48. **Atta sexdens** *L.* subsp. **lævigata** *F. Smith.* Fine series of workers from Rockstone (Lutz) and from Saveritik forest (Crampton). The latter are darker than the former.

49. **Atta cephalotes** *L.* Workers from Tumatumari (Crampton) and Tukeit (Lutz).

50. **Cryptocerus oculatus** *Spinola.* Two workers from Kaieteur (Lutz).

51. **Cryptocerus spinosus** *Mayr.* Two workers from Rockstone and Potaro Landing (Lutz).

52. **Cryptocerus maculatus** *F. Smith.* A worker minor from Tumatumari (Lutz).

53. **Cryptocerus pusillus** *Klug.* A worker minor from Georgetown (Lutz).

54. **Cryptocerus (Cephalotes) atratus** *L.* Several workers from Georgetown and Rockstone (Lutz).

55. **Crematogaster acuta** *Fabr.* Four workers from Kaieteur (Lutz).

56. **Crematogaster quadriformis** *Roger.* A single dark-colored worker from Kaieteur (Lutz).

57. **Crematogaster longispina** *Emery* subsp. **tenuicula** *Forel.* A large number of workers, Tukeit and Kaieteur (Lutz), agreeing closely with cotype specimens from Pará, Brazil.

58. **Crematogaster limata** *F. Smith* subsp. **ludio** *Forel.* Many worker specimens from Kaieteur, Tukeit and Tumatumari, B. G. and Fort Amsterdam, D. G. (Lutz) agreeing very closely with Forel's description, except in the shape of the petiole, which is distinctly narrowed in front.

59. **Crematogaster limata** *F. Smith* subsp. **parabiotica** *Forel.* Several workers from Tukeit (Lutz) agreeing very closely with cotypes from Colombia.

60. **Crematogaster brevispinosa** *Mayr* var. **tumulifera** *Emery.* Numerous workers found nesting in old moth cocoons at Georgetown (Lutz) agree with this variety except in being rather dark in color and in having the convex base of the epinotum striated. As Forel distinguishes no less than 19 varieties and subspecies of *brevispinosa* I feel disinclined to add another name till the whole group can be carefully studied with abundant material.

Subfamily Dolichoderinæ.

61. **Dolichoderus attelaboides** *Fabr.* One worker from Tukeit (Lutz) and one from Bartica (Geo. Engelhardt).

62. **Dolichoderus decollatus** *F. Smith.* Two workers from Kaieteur (Lutz).

63. **Dolichoderus (Hypoclinea) bidens** *Latr.* Several workers from Kaieteur (Lutz) and one from Bartica (Geo. Engelhardt).

64. **Dorymyrmex pyramicus** *Roger.* Two workers from Tumatumari (Lutz).

65. **Azteca instabilis** *F. Smith.* Numerous workers from Kaieteur (Lutz).

66. **Azteca jelskii** *Emery.* Numerous workers from Tukeit (Lutz).

67. **Azteca sericea** *Mayr.* Several media and minor workers from Kaieteur (Lutz).

Subfamily CAMPONOTINÆ.

68. **Brachymyrmex patagonicus** *Mayr.* More than a dozen workers from Kaieteur and six deälated females from Tukeit (Lutz).

69. **Prenolepis (Nylanderia) longicornis** *Fabr.* A few workers taken on board the steamship "Korona."

70. **Prenolepis (Nylanderia) cæciliæ** *Forel.* Numerous workers and three winged females from Kaieteur (Lutz).

71. **Prenolepis (Nylanderia) lietzi** *Forel.* Four workers from Kauwa Creek, Roraima (Crampton).

72. **Gigantiops destructor** *Fabr.* Several workers and a deälated female from Kaieteur, Tukeit and Tumatumari (Lutz).

73. **Dendromyrmex fabricii** *Roger.* Three workers and a deälated female from Tukeit (Lutz), together with their small carton nest on the under side of a leaf. The worker agrees very closely with Roger's description based on specimens from Surinam. The female measures about 7 mm. and very closely resembles the worker except that the basal segments of the gaster are darker and the legs are deep red instead of testaceous.

74. **Dendromyrmex fabricii** *Roger* var. **rufescens** var. nov.

Worker. Differing from the typical form in color, the whole body and the appendages being ferruginous red, the gaster considerably darker and more brownish, with the posterior portions of each segment blackish and the clypeus, mandibles and anterior border of the head more yellowish. The appressed pubescence on the gaster is a little sparser than in the typical form, so that the punctate integument is more clearly visible.

Numerous specimens from Tukeit (Lutz).

75. **Dendromyrmex nidulans** *F. Smith* var. **nigripes** var. nov.

Worker. Differing from the typical form in having the legs and antennal funiculi black or very dark brown, with only the terminal tarsal joints and the tip of the last funicular joint reddish. The gaster is golden brown as in typical specimens from Brazil.

Female. Differing from the female of typical *nidulans* in the same characters as the worker. The wings have the veins bordered with dark brown as in the type.

Several workers and a single female from Kaieteur (Lutz).

76. **Dendromyrmex chartifex** *F. Smith* var. **felis** *Mann* (MS.).

Worker. Differing from the typical form in having the body opaque and densely and finely punctate. Hairs on the head, thorax and gaster somewhat more abundant. There is no appreciable difference in color.

Female (deälated). Length 10.5 mm. Very closely resembling the worker. Numerous workers and a single female from Tukeit, in the fold of a leaf the edges of which had been drawn together and fastened with silk by a spider (?) (Lutz).

77. **Camponotus (Dinomyrmex) agra** *F. Smith.* Two minor workers from Kaieteur (Lutz).

78. **Camponotus (Dinomyrmex) mocsaryi** *Forel.* Three minor workers from Kaieteur (Lutz). The upper surface of the gaster is opaque and yellow, with a narrow transverse black band near the posterior edge of each segment. Forel does not describe the gaster but Emery mentions the black bands in the worker of this species (Rend. Accad. Inst. Sc. Bologna 1903, p. 20).

79. **Camponotus (Myrmothrix) rapax** *Fabr.* Several major and minor workers from Tukeit (Lutz).

80. **Camponotus (Myrmothrix) abdominalis** *Fabr.* Seven workers of the typical form of this variable species from Tukeit and Kaieteur (Lutz) and Bartica (Geo. Engelhardt). Three of the specimens, a media and two minors, are attached to leaves and have a fungus (*Cordyceps unilateralis* Tul.) growing out of the top of the head.

81. **Camponotus (Myrmosphincta) sexguttatus** *Fabr.* var. **fusciceps** *Emery.* Several workers and a deälated female from Kaieteur (Lutz). The head and antennal scapes of the female are black, the mandibles and funiculi deep red.

82. **Camponotus (Myrmamblys) novogrenadensis** *Mayr.* Eight workers from Fort New Amsterdam, Paramaribo, Dutch Guiana (Lutz).

83. **Camponotus (Myrmobrachys) senex** *F. Smith.* Numerous workers from Kaieteur and Tukeit (Crampton and Lutz).

84. **Camponotus (Myrmorhachis) rectangularis** *Emery.* A single worker from Tumatumari (Lutz).

85. **Camponotus (Myrmorhachis) latangulus** *Roger.* A single worker from Tumatumari (Lutz).

59.57,72M(81)

Article II.— NEW AND NOTEWORTHY BRAZILIAN MUSCOIDEA COLLECTED BY HERBERT H. SMITH.

By Charles H. T. Townsend, U. S. National Museum.

During the eighties of the past century Mr. Herbert H. Smith made rather an extensive collection of Diptera in Brazil, mainly in the southern part of that country. The American Museum of Natural History has acquired by purchase, through Dr. S. W. Williston, most of this collection, and has placed in the hands of the writer for study the material in the muscoid groups. The present is the first of a series of papers giving results of this study. In addition to the new forms, a record is presented of the more noteworthy described forms secured.

The greater part of the material is labeled simply "Chapada." As there are several large towns of this name in widely removed parts of Brazil, it is important to fix definitely this locality. The Chapada in question, properly written Santa Anna da Chapada, is a small village near Cuyabá, on the headwaters of the Paraguay River, in the province of Matto Grosso.

Uramya producta *R. D.* Two males, no locality, labeled only "611." Eyes only thinly hairy. Abdomen cylindrical. Legs very elongate, especially middle ones; middle tibiæ and metatarsi longest, hind and middle femora about same length. Arista tomentose or clothed with short hairs.

Euloewia ochreicornis new species.

Length of body, 5 to 6 mm.; of wing, 4 to 5 mm. Two males and two females, Chapada, Nov.

Differs from *E. madrensis* T. as follows: Antennæ wholly ochreous. Palpi dark rufous, blackish basally. Third antennal joint nearly or quite twice as long as second in both sexes. Tegulæ deeply smoky-yellow. Parafacials of male not so broad.

Holotype, No. 22575 Am. Mus. N. H., male; allotype, female. Paratypes, No. 20010 U. S. Nat. Mus., male and female.

Atactomima new genus.

Genotype, *Atactomima crescentis* new species.

Differs from *Atacta* as follows: Face extremely flattened; facialia much widened, perfectly flat, quite in the plane of clypeus. Facial plate not over twice as long as epistomal width. Front wider, vertex of female about two-fifths of head-width, the narrowest part of front of male over one-sixth of head-width. Face wider, faciofrontal area much greater in proportion to ocular area, the parafrontals and parafacials in male forming in front view a heavy crescentic or subarcuate area. Frontal bristles sparsely placed, only six to eight or nine pairs. Female with only two proclinate orbitals. Frontalia not so broad. General form less robust and less elongate. Male claws more slender.

Atactomima crescentis new species.

Length of body, 9.5 to 10 mm.; of wing, 8 to 8.75 mm. Four males and one female, Chapada, one male labeled May.

Differs from *Atacta brasiliensis* Sch. in coloration only as follows: Front, face and cheeks entirely silvery in male; in female there is a light golden tinge to all except the facialia and the black orbital vitta of parafrontals. Antennæ and palpi rufous to fulvous, shading more or less to brownish on third antennal joint and to dark rufous on base of palpi. All the pollinose parts of male silvery; in female the pollen of mesoscutum, humeri, mesopleuræ and anal abdominal segment is pale golden. Tegulæ white, the hind scale usually with ground-glass effect. The frontalia are lighter.

Holotype, No. 22576 Am. Mus. N. H., male; allotype, female. Paratype, No. 20011 U. S. Nat. Mus., male.

Frontocnephalia new genus.

Genotype, *Frontocnephalia angusta* new species.

Allied to *Germariopsis*, differing as follows: Male. Form narrowed. Lower profile of head considerably shorter than frontal profile, the two profiles parallel. Facial profile receding, as long as frontal profile. Facial depression deeply excavated, narrow, about twice as long as broad, the facialia nearly parallel, the epistoma not projecting in profile beyond the facialia. Third antennal joint four times as long as the second. (Arista wanting.) Facialia finely ciliate a little less than half way up. Parafacials rather irregularly bristled, considerably narrowed below. Proboscis below geniculation about as long as antennæ, slender, corneous. First abdominal segment with long median marginal pair of bristles, no discals on anal segment but rather strong marginals. Third vein bristled half way to small crossvein, costal spine developed. Apical cell closed in margin a little nearer to wing-tip.

Frontocnephalia angusta new species.

Length of body, 9 mm.; of wing, 6.5 mm. One male, Santarem.

Head silvery; a brassy tinge on front, less marked on parafacials. First two antennal joints and palpi pale rufous, third joint blackish. Frontalia brownish, with thin coat of pollen. Thorax and scutellum blackish, latter reddish on apex, pollen of mesoscutum tinged with brassy, four subequal black vittæ reaching nearly to scutellum. Abdomen blackish; brassy-silvery pollinose except first segment, median vitta and broad hind margins of second to fourth segments, the dark parts with thin sheen of pollen. Venter brown. Legs blackish. Wings very faintly tinged with smoky. Tegulæ white.

Holotype, No. 22577 Am. Mus. N. H.

Beskiocephala new genus.

Genotype, *Beskiocephala flava* new species.

Has strong suggestion in head-characters of *Beskia,* especially in antennæ; but proboscis, abdomen and wings are totally different. Differs from *Aphria* as follows: Female only. Vertex fully twice as wide as one eye. Ocellar and postocellar bristles delicate, short. Outer verticals strong, inner ones decussate. Head subquadrangular in profile; antennæ inserted on upper fifth or sixth of eye, first joint elongate and erect, second distinctly longer than the first; third joint over three times as long as the second, stout-subcylindrical, the distal half widening blade-like with evenly rounded lower-apical profile, the distal fourth flattened out and thin. Arista about as long as third antennal joint, its first and third joints about equal, its second joint a little longer than the others. Epistoma feebly prominent; vibrissæ weak, short, not decussate; peristomal bristles very sparse, weak. Parafacials wide, with facio-orbital bristle at lower end of eye; a stronger proclinate orbital just above middle level of eye and below base of antennæ, two detached frontals opposite and immediately below the latter orbital; a weaker proclinate orbital above last on parafrontals; and three reclinate orbitals successively stronger posteriorly, the third more or less nearly in line with frontals. Cheeks rather over one-half eye-height. Proboscis elongate, rather stout, corneous, part below geniculation nearly one and one-half times head-height; no palpi. Four strong scutellars, no small apical pair. Abdomen rather inflated, suboval, median pair of macrochætæ separated from rest of marginal row of third segment. Anal segment cut off posteriorly, with same sparse appressed microchætæ as rest of abdomen. Front tarsal joints two to four slightly widened. Third vein bristled to small crossvein, costal spine short, apical cell very narrowly open and ending far before wing tip, third vein bent up at tip, apical crossvein nearly straight after its inward curve at base, cubitus with strong stump; hind crossvein gently sinuate, almost in line with apical crossvein, well approximated to cubitus. Hind scale of tegulæ not so large. Tarsi stouter.

Beskiocephala flava new species.

Length of body, 7.5 mm.; of wing, 6.5 mm. One female, Chapada, Nov.

Head wholly luteous, showing a thin coat of silvery-white pollen in very oblique view especially on face and parafrontals. Frontalia anteriorly, first two antennal joints and base of third fulvous, rest of third joint and arista blackish. Proboscis fulvous, blackish toward apex. Thorax and scutellum fulvous, thinly silvery, mesoscutum with four rather heavy and nearly equal brownish vittæ. Abdomen wholly fulvorufous, with faint indications of silvery pollen. Legs fulvous, the tibiæ of slightly deeper shade than the femora and coxæ, the tarsi blackish. Wings smoky except on broad posterior border, the baso-costal area to small crossvein and end of first vein yellow; tegulæ of about the same light bright yellow.

Holotype, No. 22578 Am. Mus. N. H.

Formicomyia new genus.

Genotype, *Formicomyia ovata* new species.

Allied to *Copecrypta,* from which it differs as follows: Female. All macrochætæ weak. Only one proclinate orbital, the two reclinate orbitals set farther forward; only five frontals, set more forward and sparsely disposed. No apical short decussate pair of bristles on scutellum, only a small discal pair and two long lateral pairs. Thorax rather narrower than abdomen. Abdomen strongly elongate-eggshaped, inflated, the greatest width being rather behind middle; first incisure strongly arcuate, the second and third markedly so. Apical crossvein rather evenly curved; hind crossvein straight, parallel with main course of apical; the axes of both crossveins nearly perpendicular to fifth vein. Hind crossvein rather close to halfway point between small crossvein and cubitus. Third antennal joint but little widened, nearly twice as long as second.

Formicomyia ovata new species.

Length of body, 6 mm.; of wing, 4.5 mm. One female, Chapada, Nov.

Head yellowish, parafrontals polished black; frontalia and antennæ fulvorufous, the third joint of latter darkened apically. Face silvery. Thorax and scutellum shining blackish, thinly silvery, with four subequal brown vittæ. Abdomen polished rufous-brown, showing no pollen except the faintest indication at first incisure and sides of second. Legs concolorous with abdomen, tarsi darker. Wings faintly smoky, showing most on crossveins and along costal border. Tegulæ nearly white.

Holotype, No. 22579 Am. Mus. N. H.

Microgymnomma new genus.

Genotype, *Microgymnomma orbitalis* new species.

Runs to *Gymnomma* in Brauer & Bergenstamm's 1893 table of Pyrrhosiidæ, differing as follows: Male. Two strong proclinate orbitals on each side; third antennal joint a little over twice as long as second, but little widened, of even width, evenly rounded at tip; first two aristal joints short; claws short, hardly or barely as long as last tarsal joint; proboscis corneous, moderately stout, but little longer than head-height; cubitus with strong stump extending half way or more to wing-margin; no discal macrochætæ on intermediate abdominal segments. Strong proclinate ocellars present. Front very broad, vertex fully one-third head-width. Abdomen strongly oval, swollen, the smaller end apical. Epistoma but slightly produced. No median macrochætæ on first abdominal segment, short median marginal pair on second, sparse marginal row of longer ones on third, discal and marginal on fourth. Hypopygium small. Two very long lateral scutellar macrochætæ, a shorter one between them. Two very long macrochætæ on each side of mesoscutum behind suture. Middle tibiæ with a very long spine; tarsi rather slender. Wings very broad in proportion to length, rather short; third vein bristled over half way to small cross vein; apical cell strongly concave at end, ending well before wing-tip, its opening attenuate and narrow.

Microgymnomma orbitalis new species.

Length of body, 5 mm.; of wing, 4.75 mm. One male, Chapada, Dec.

Head pale flavous; facial plate silvery, parafacials and parafrontals brassy;

frontalia and antennæ smoky-fulvous, the first two joints of latter light fulvous; cheeks and occiput thinly brassy-silvery. Thorax and scutellum polished black, thinly brassy pollinose, leaving four subequal vittæ before suture; humeri and pleuræ more thickly brassy. Abdomen polished black; narrowly silvery at incisures, faintly brassy, spreading somewhat according to lights especially at sides. Legs brown, tarsi blackish. Wings faintly tinged with smoky throughout. Tegulæ nearly white.

Holotype, No. 22580 Am. Mus. N. H.

Chrysometopiops new genus.

Genotype, *Chrysometopiops smithii* new species.

Allied to *Argyreomyia*, from which it differs as follows: Male. Eyes almost bare. No proclinate orbital in male, but three reclinate orbitals. Normally a fine hairlike pair of ocellars present, sometimes not developed. Frontal development of male almost same, but the frontalia extending nearly to ocellar area in a more or less suturelike form. Epistoma distinctly more extended below vibrissæ. Antennæ inserted distinctly above eye-middle. Four sternopleurals, and four postsuturals. Discal scutellars not so widely separated. No discals on intermediate abdominal segments. Tegulæ not so greatly enlarged. Third vein bristled only at base, usually with only a single bristle. Hind tibiæ pectinate. A pair of pilose spots on venter of third segment.

Female. Differs from the male only in the frontalia being wider, not constricted suturelike, but narrowing posteriorly to a point; in the presence of two proclinate orbitals, the front being only a little wider than in the male; and in lacking the pilose spots of venter of third segment. The claws are short in both sexes.

Chrysometopiops smithii new species.

Length of body, 7 to 8 mm.; of wing, 5.75 to 6 mm. Twenty-seven males and ten females, Chapada, Nov., except one of each sex Abrilongo, Jan.

Golden pollinose, evidently golden-green in life. Head silvery; mesoscutum and scutellum of male with a decided silvery effect in some lights, less evident or wanting in female. Antennæ and frontalia dark brown or blackish. Palpi rufous, lighter apically. Male without thoracic vittæ, female with only the faintest indication of same. First abdominal segment and rather broad hind borders of other segments dark brown or blackish. Venter of first two segments largely silvery, the third segment blackish with narrow front border of golden in male, which spreads more or less posteriorly in female. Pleuræ silvery. Legs concolorous with dark parts of abdomen. Wings lightly infuscate, less so on inner border. Tegulæ tawny-whitish to pale yellowish, with narrow yellow margin. Pile of ventral spots of third abdominal segment of male black, but appearing fulvous in some lights.

Holotype, No. 22581 Am. Mus. N. H., male; allotype, female. Paratypes, No. 20012 U. S. Nat. Mus., male and female.

Named in honor of Mr. Herbert H. Smith.

Chrysosturmia new genus.

Genotype, *Chrysosturmia orbitalis* new species.

Allied to *Chrysometopiops*, from which it differs as follows: Male. Front and face wider, vertex nearly as wide as one eye, the front widening anteriorly; a pair of strong proclinate orbitals in male; strong pair of proclinate ocellars; two reclinate orbitals, the frontalia and parafrontals normal. Facialia strongly ciliate more than half way up. Two to four bristles at base of third vein. Frontalia of perfectly even width, about two-thirds as wide as the middle of one parafrontal. Antennæ slightly longer. Vestiture spots of venter of third segment larger. Chætotaxy of scutellum and abdomen same; the main bristles of thorax same.

Chrysosturmia orbitalis new species.

Length of body, 7.75 mm.; of wing, 6.5 mm. One male, Chapada, Nov.

Face, cheeks and occiput silvery, parafrontals golden; frontalia, palpi and antennæ black or very dark brown, the last with a pollinose sheen. Thorax, scutellum and abdomen golden, the pleuræ more silvery; two median well-defined narrow black vittæ on mesoscutum, with a brownish one between same behind suture, a lateral interrupted black vitta of the semicolon type but extending well posteriorly. First abdominal segment, broad hind borders of second and third segments and median vitta on same dark brown, the dark border of third segment widening laterally to cover whole of venter of that segment. Ventral vestiture of third segment black. Legs black, tibiæ with a brownish tinge. Wings very faintly infuscated, more distinctly so on costal half. Tegulæ very pale yellowish, the front scale more nearly white. Apparently golden-green in life.

Holotype, 22582 Am. Mus. N. H.

Xanthozona melanopyga *Wied.* One male, Chapada, Dec. Claws long; strong proclinate orbitals in male, no ocellars. Front and vertex practically same width in both sexes. Female front tarsi considerably widened. Second and third antennal joints nearly equal, the third convex on front border. Second aristal joint distinctly elongate. Frontalia much widened anteriorly. Anal segment long, its front border strongly arcuate. Abdomen swollen-eggshaped, small end apical. The female characters are from U. S. Nat. Mus. material.

Macrojurinia new genus.

Genotype, *Jurinia brasiliensis* Desvoidy, 1830, Myod., 35.

This is the species figured by Williston on page 44 of the third edition of his Manual of North American Diptera (1908). The form is very broad and flattened, surpassing that of *Paradejeania* in this respect; the palpi are rounded apically, heavy and bowed, of distinct type from those of *Jurinia* and *Paradejeania*. Female front tarsi widened. Female abdomen especially broadened and emarginate behind.

Eyes bare. Ocellar bristles absent. Male vertex rather over one-third head-width, that of female but little wider. Female with two strong proclinate orbitals, male without same. Proboscis heavy and corneous, rather short; palpi shorter than antennæ. Second aristal joint elongate. Scutellum and abdomen thickly covered with erect spines; no sagittal rows.

Four females and one male, Chapada, two of them labeled Nov. The females measure as long as 18 mm., with 11 mm. breadth of abdomen. All agree perfectly with Desvoidy's description; the form is a well-marked one, the black front especially distinguishing it at once.

In this connection, it becomes necessary to point out that *Pseudohystricia* B. B. (genotype, *ambigua* Mcq.) is a synonym of *Jurinia* R. D. (genotype, *gagatea* R. D.), since the genotypes are strictly congeneric. I identify both species quite unmistakably in Peruvian material. Brauer & Bergenstamm's designation of *Tachina obesa* Wd. as type of *Jurinia* cannot hold, as that species was not originally included; Coquillett's designation of *gagatea* R. D. appears to be valid. In the above comparison, *Jurinia* therefore represents *Pseudohystricia* B. B., and is used purely in that sense.

Chrysoexorista viridis *T.* **angustifrons** new subspecies.

Length of body, 6.5 to 9 mm.; of wing, 5.75 to 7 mm. Six males, Chapada, Nov.

C. viridis was described recently on a single specimen of each sex taken by the writer in the montanya of southeastern Peru. The Chapada males show the front much narrower than described for the Peruvian male. The vertex averages two-thirds of one eye in width, but is even less in some specimens. The frontalia are narrowed considerably posteriorly in most of the specimens. The material evidently represents a distinct subspecies.

Holotype, No. 22583 Am. Mus. N. H. Paratype, No. 20013 U. S. Nat. Mus.

Macromeigenia aurea new species.

Length of body, 11 mm.; of wing, 8.5 mm. One female, Chapada, Jan.

Differs from *M. chrysoprocta* Wied. as follows: Eyes almost bare, with only very sparse indistinct hairs. No median macrochætæ on first two abdominal segments, or at most a vestigial marginal pair on second; no discal on third. Pollen of whole dorsum distinctly golden. Four heavy black thoracic vittæ, and a fifth one behind suture. Anal segment more heavily golden pollinose and showing less rufous. Wings distinctly infuscate on costal portion, to less extent along veins.

Holotype, No. 22584 Am. Mus. N. H.

Wiedemann's description indicates that his material was from North America. His description does not apply to this Brazilian form.

Beskia cornuta *B. B.* One male, Chapada. The antennæ resemble those of the North American and West Indian forms.

Bibiomima handlirschi *B. B.* One female, Chapada, Jan. This very remarkable and most striking fly appears to be an aberrant member of the Phasiidæ. The facial characters approach those of the Rhodogynidæ. In its whole form and coloration, including the peculiar pattern of wing-infuscation, this fly is a counterfeit of the widely distributed tropical American *Plecia plagiata* Wied. Even the upwardly-incurvate abdomen in the present specimen simulates the posture of the male abdomen in that species. Brauer & Bergenstamm remark on this resemblance.

Cylindrophasia new genus.

Genotype, *Ocyptera simillima* Fab., 1805, Syst. Antl., 313; *Phania simillima* Wied., 1830, Auss. Zweifl. Ins., II, 267–8.

Comes nearest to *Polistomyia* Towns. on male and female hypopygial characters. Differs in the cylindrical abdomen; hind tibiæ with scanty or short cilia, often very sparse in female; wings clear on more than inner half. Ovipositor flattened and very narrow, sinuate in profile, chitinous, polished; with a pair of elongate forceps-like guards approximated to its dorsal surface, the guards bearing hairs on dorsum except at tips. Male hypopygium placed ventroapically, its basal plate rather longer than wide. Male abdomen very narrow, of absolutely even width. Female abdomen slightly wider.

Three females and one male, Chapada, one of the females labeled Dec. These agree well with Wiedemann's description. The hind tibiæ of the male are wholly black. An oblique silvery patch shows on each side of first three abdominal segments, especially in the male.

59.82(67.5)

Article III.— FOUR NEW BIRDS FROM THE BELGIAN CONGO.

By James P. Chapin.

This second preliminary paper on the ornithological results of the Congo Expedition of the American Museum, under the leadership of Mr. Herbert Lang, consists of descriptions of four new species of birds from the Ituri and Upper Uele Districts of the Belgian Congo.

I wish to express my thanks to Dr. E. A. Mearns of the U. S. National Museum for his kindness in examining specimens of two of these forms.

Stilbopsar leucothorax sp. nov.

Type.— Collector's No. 4891, Congo Expedition Am. Mus. Nat. Hist., ♂ ad., Pawa, in the Mabudu country of the northern Ituri District, Belgian Congo, July 15, 1913.

General characters.— Referred provisionally to the genus *Stilbopsar*, although not very closely allied to the two species already known, being much larger, without rufous on the primaries in either sex, and the adult male with a large white breast-band.

Adult Male (type).— Plumage entirely glossy black, excepting a pure white band, nearly an inch wide, crossing the breast and running well up on the sides of the neck. The reflections on the remiges and greater wing-coverts are deep delft-blue[1]; but those on the head, back, and elsewhere dark bluish violet, even on the sides, abdomen, and under wing and tail-coverts, though the rectrices seem to have lost most of their luster through wear. This gloss, it should be stated, is not to be compared with that commonly displayed by members of the genus *Lamprocolius*, but is very much duller, and instead bears a strong resemblance to that of many Crows. Both remiges and rectrices viewed from beneath appear dull black.

Iris deep cadmium-yellow; bill black; feet black, a little yellowish on soles.

The nostril is rounded, and resembles that of *Poeoptera lugubris* (the nearest relative available for comparison), but the bill is far stouter, and the gonys straight. Indeed, in general outline it agrees well with that of the female of *Stilbopsar kenricki* figured by Mr. Grönvold in Captain Shelly's Birds of Africa, Vol. V, pl. xlix. Rictal bristles are present, but not conspicuous. Wing pointed, its tip extending 30.5 mm. beyond the longest secondary. Outermost primary exceeds primary coverts by 1.5 mm.; 8th primary longest, but very nearly equalled by 7th and 9th. Tail rounded, outer feathers 15.5 mm. shorter than the median. Feet like those of *Poeoptera* in form.

Length (skin) 218 mm.; wing, 128; tail, 94; bill (exposed culmen), 16; depth at nostril, 6; width at nostril 7; metatarsus, 25; middle toe and claw, 25.

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[1] Colors named according to Ridgway's 'Color Standards and Nomenclature.'

Adult Female (No. 4892, Pawa, July 15, 1913).— Wings, rump, upper tail-coverts, and rectrices glossy black like those of male, but crown and back fuscous-black, with scattered violet feathers. General color below, from throat to abdomen, hair-brown; but freshly molted feathers slightly glossy, deep mouse-gray, with paler tips. Under tail-coverts darker, with blue sheen and gray edgings. Iris cadmium-yellow, bill and feet black.

Length (skin), 200 mm.; wing, 117; tail, 83; exposed culmen, 16; metatarsus, 22.5; middle toe and claw, 23.

Immature Female (No. 4893).— Resembles adult female, but wings and tail much less glossy. There are some violet feathers appearing, however, on the back and nape.

Wing, 113; tail, 69; bill (exposed culmen), 15.5 mm.

Remarks.— These three birds, shot from a flock frequenting tall trees, had been feeding on berries and other fruit. The species was never met with again.

Paludipasser uelensis sp. nov.

Type.— Collector's No. 4482, Congo Expedition, Am. Mus. Nat. Hist., ♂ ad. Faradje, Upper Uele District, Jan. 18, 1913.

General characters.— This species is apparently referable to the genus recently founded by Mr. S. A. Neave on two young birds from Lake Bangweolo (Bull. B. O. C., XXV, p. 25); the resemblance is especially striking in the thick bill, with compressed maxilla and the culmen continuing back on the forehead. In our examples the metatarsus is decidedly longer than in the Waxbills, to which it seems related, and the hind claw but slightly curved and unusually long, evidently in connection with terrestrial habits. In his description Mr. Neave does not mention the feet, but in the figure (Ibis, 1910, pl. iii) the metatarsus is of the same length as ours and there is an indication of a long hind claw. The muscular part of the legs — I noticed in skinning — is exceedingly well-developed, and stouter than in any other member of the subfamily *Estreldinæ* I have examined.

One of our specimens has been examined by Dr. E. A. Mearns, who agrees with me that it is probably closest to the genus *Paludipasser*.

Although the adult plumage of *P. locustella* is still unknown, I believe we are justified in describing the present adult specimens, so different in color, under a new specific name, especially in view of the enormous distance (14 degrees of latitude) separating the two localities.

Adult Male (type).— Forehead, lores, superciliary region, and ear-coverts nopal-red, shading to scarlet on throat and upper breast. Crown, nape, back, and rump fuscous, feathers of crown and nape with black centers; lateral tail-coverts broadly tipped with scarlet but the long median pair wholly fuscous. Tail rounded; rectrices fuscous-black, all but the median pair more or less bordered externally with scarlet. Lesser and middle wing-coverts scarlet; greater wing-coverts fuscous, broadly edged with scarlet; remiges fuscous, shading to dirty whitish on inner edge and all but the inner secondaries and the 9th and 10th primaries with a scarlet edge on the outer web, the 9th primary being margined with very pale brown; 10th primary very narrow and pointed, reaching slightly beyond the primary coverts; 7th and 8th primaries longest, but sometimes equalled by the 9th; longest secondary

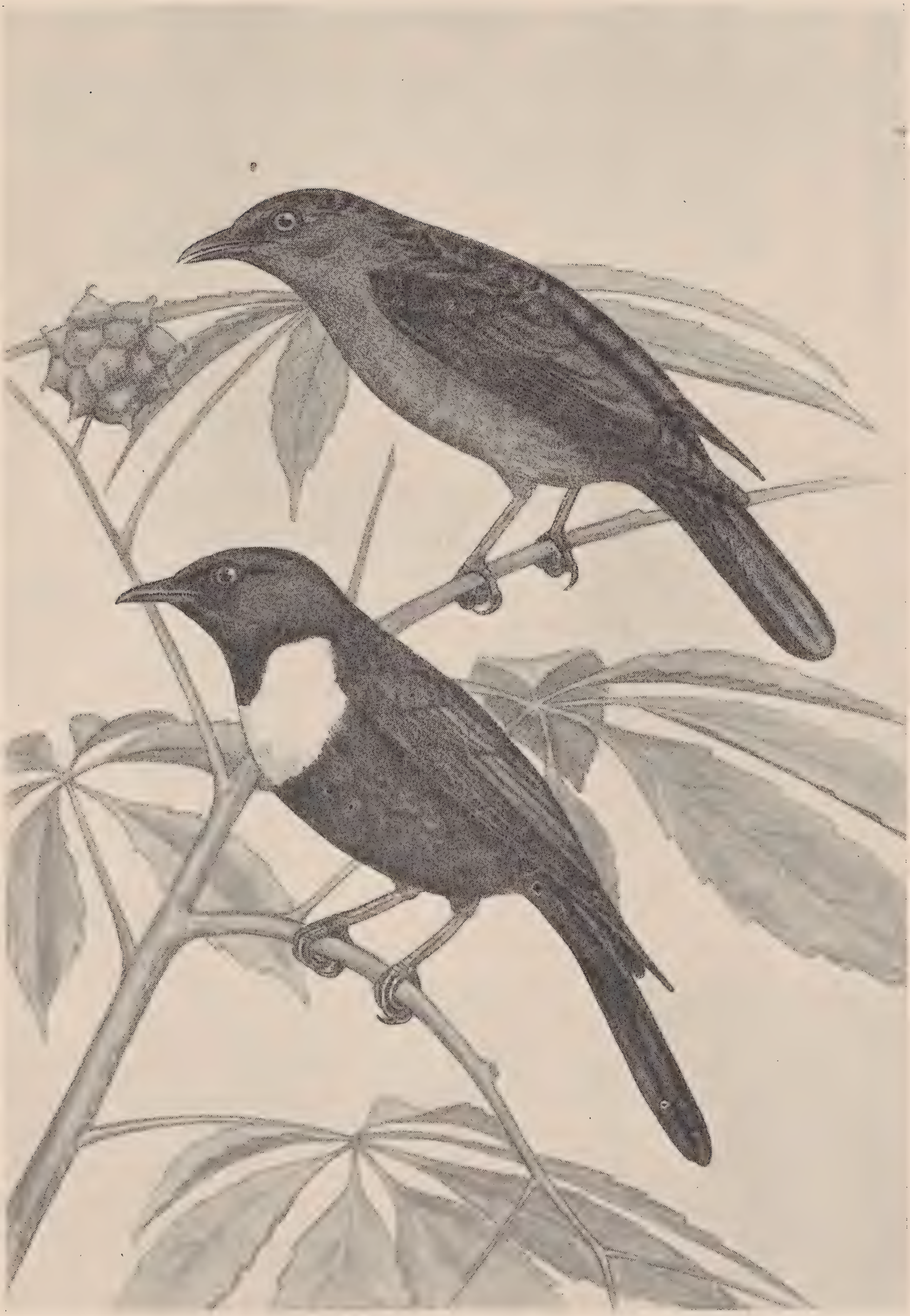

Fig. 1. *Stilbopsar leucothorax*, Male and Female. One-half natural size.

reaching almost to tip of wing, under wing-coverts whitish. Lower breast and sides fuscous-black, belly slightly lighter, but under tail-coverts blackish, the longer ones narrowly tipped with whitish.

Iris yellow; maxilla mostly blackish, but its lower edge, as well as whole mandible bright red; feet brown.

Length (skin), 82 mm.; wing, 43; tail, 29 (outer feathers 5.5 shorter); bill (culmen to base), 8.8; depth of bill (from base of culmen to posterior corner of mandible), 8.5; metatarsus, 14; hind toe with claw, 13; claw, 6.5.

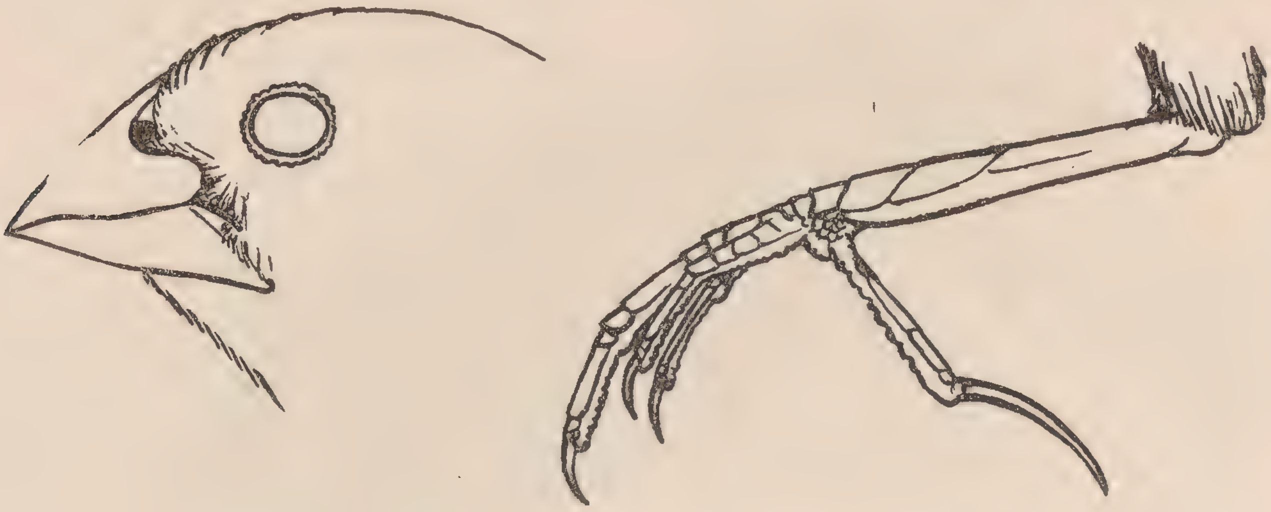

Fig. 2. *Paludipasser uelensis.* Twice natural size.

Other specimens of this sex are sometimes bordered with whitish on the feathers of the abdomen and the innermost secondaries.

Adult Female (No. 4484, Faradje, Jan. 18, 1913).— No red on forehead, cheeks, or breast. Forehead fuscous; crown, back, wings, tail-coverts, and tail very similar to those of male, but outermost pair of rectrices with narrow white tips. Lores and a faint superciliary line whitish; cheeks and ear-coverts fuscous; throat, breast, and abdomen soiled white. Under tail-coverts blackish, longer ones narrowly tipped with whitish. Colors of eyes, bill, and feet of female same as those of male.

Length (skin), 82 mm.; wing, 44; tail, 30; bill, 9; metatarsus, 14.

Measurements of nine males.— Wing, 42–44; tail, 28–30; bill (culmen to base), 8.7–9.

Measurements of three females.— Wing, 42–44; tail, 27.5–30; bill (culmen to base), 9.

Remarks.— Low marshy spots, which have dried up and been burned over in the rainless season, seem to be the favored haunts of these silent little birds. They are by no means common, but associate in companies of three to fifteen, feeding on the ground amid the burned tussocks and long charred grass stalks, rising with a faint whir of wings only when approached very closely, and then flying off in a body, frequently to a distance of fifty or a hundred yards before alighting again. On two occasions they were also found on higher ground in old fields, but never perched on bushes or even on the grass. As they were always invisible when on the ground, specimens could only be secured on the wing. Though steady and direct, the flight is not rapid; and no notes were ever heard. Their food consists of tiny seeds; and during two successive years the species was observed in this region (Niangara, Faradje, Garamba) from January 18th to June 20th.

Malimbus flavipes sp. nov.

Type.— Collector's No. 5067, Congo Expedition Am. Mus. Nat. Hist., ♀ ad. (breeding), Avakubi, Ituri District, Belgian Congo, Sept. 20, 1913.

General characters.— Referred to the genus *Malimbus* mainly on account of its wholly black plumage and the general form of the bill, but the nostril much larger than that of any other species of *Malimbus, Melanopteryx,* or *Cinnamopteryx* known to the writer, measuring 3 mm. in length by 2 mm. in width, and exposing a conspicuous turbinal structure.

Description of Type (adult female).— Entirely black, with the exception of blackish brown under tail-coverts, and the inner edges of remiges shading to gray. Bases of body feathers gray; plumage decidedly glossy, especially on breast, crown, and back; feathers of nape with a rather ruffled aspect. Outermost (10th) primary exceeding primary coverts by 6 mm., 8th primary longest, 9th primary equal to the 5th. Tail square. Iris light yellow; bill black; feet rather dull light yellow.

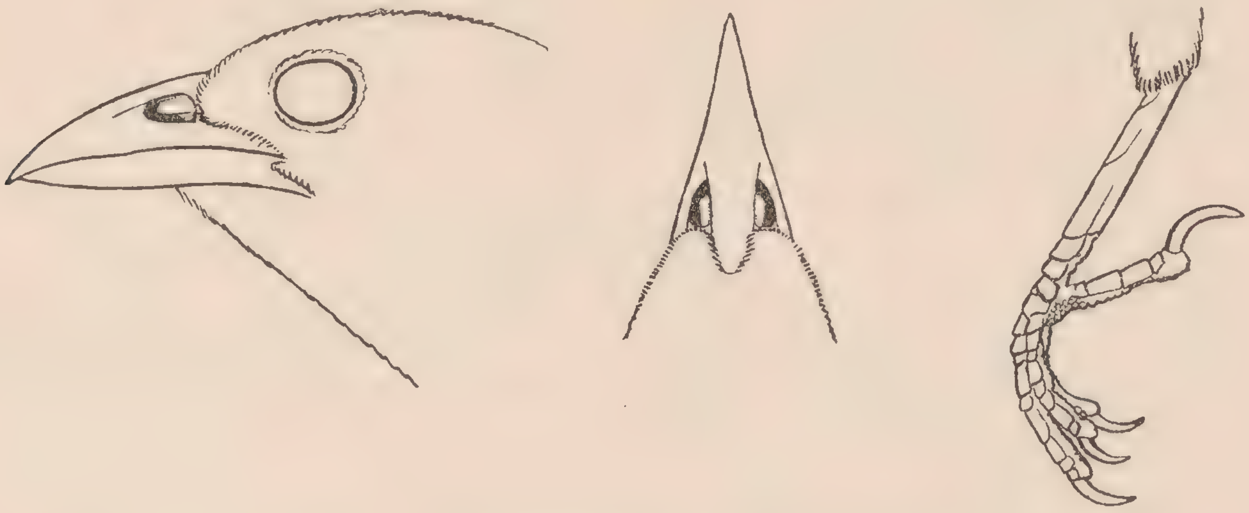

Fig. 3. *Malimbus flavipes.* Natural size.

Measurements.—Length of skin, 125 mm.; wing, 76; tail, 42; bill (culmen to base), 18; metatarsus, 18.5.

Remarks.—Only this single specimen secured, in the forest. Stomach contents, small caterpillars.

Avakubi is the type-locality of *Malimbus gracilirostris* Reichenow, which has proved to be the female of *M. coronatus.* We collected in all, in this region, four pure black Weaver Birds, the two others being *Melanopteryx maxwelli,* hitherto known only from Fernando Po and the Kamerun, and the widely distributed *Melanopteryx nigerrimus.*

Bradypterus carpalis sp. nov.

Type.— Collector's No. 4531, Congo Expedition, Am. Mus. Nat. Hist., ♂ ad., Faradje, Upper Uele District, Belgian Congo, Feb. 21, 1913.

General characters.— In color somewhat resembling *B. babæculus,* but larger, with lesser wing-coverts white, and tail with only 10 rectrices (*B. babæculus,* according to Ogilvie-Grant, has 12). These are rather broad, without pointed tips or decomposed webs. Dr. E. A. Mearns has very kindly compared one of our specimens with *Bradypterus babæculus fraterculus* and three other species of the genus in the U. S. National Museum, and assures me of its specific, perhaps even generic, distinctness.

Adult Male (type).— General color of upperparts, including wings and tail, mummy-brown, crown and forehead slightly darker. Lesser wing-coverts white, with concealed fuscous-black bases; middle coverts fuscous tipped with whitish, greater coverts fuscous bordered on the outer web with lighter brown. Most of the remiges brownish white on the inner edge. A faint superciliary line starting from near the nostril is whitish; ear-coverts, cheeks and lores mostly fuscous, but with fine whitish shaft-streaks. Chin, throat, middle of breast and abdomen white, slightly soiled (no grayish breast-band), but throat and upper breast heavily marked with large, roughly triangular spots of blackish brown. Sides of breast and flanks hair-brown; under tail-coverts chætura-drab with broad white tips. Under wing-coverts white.

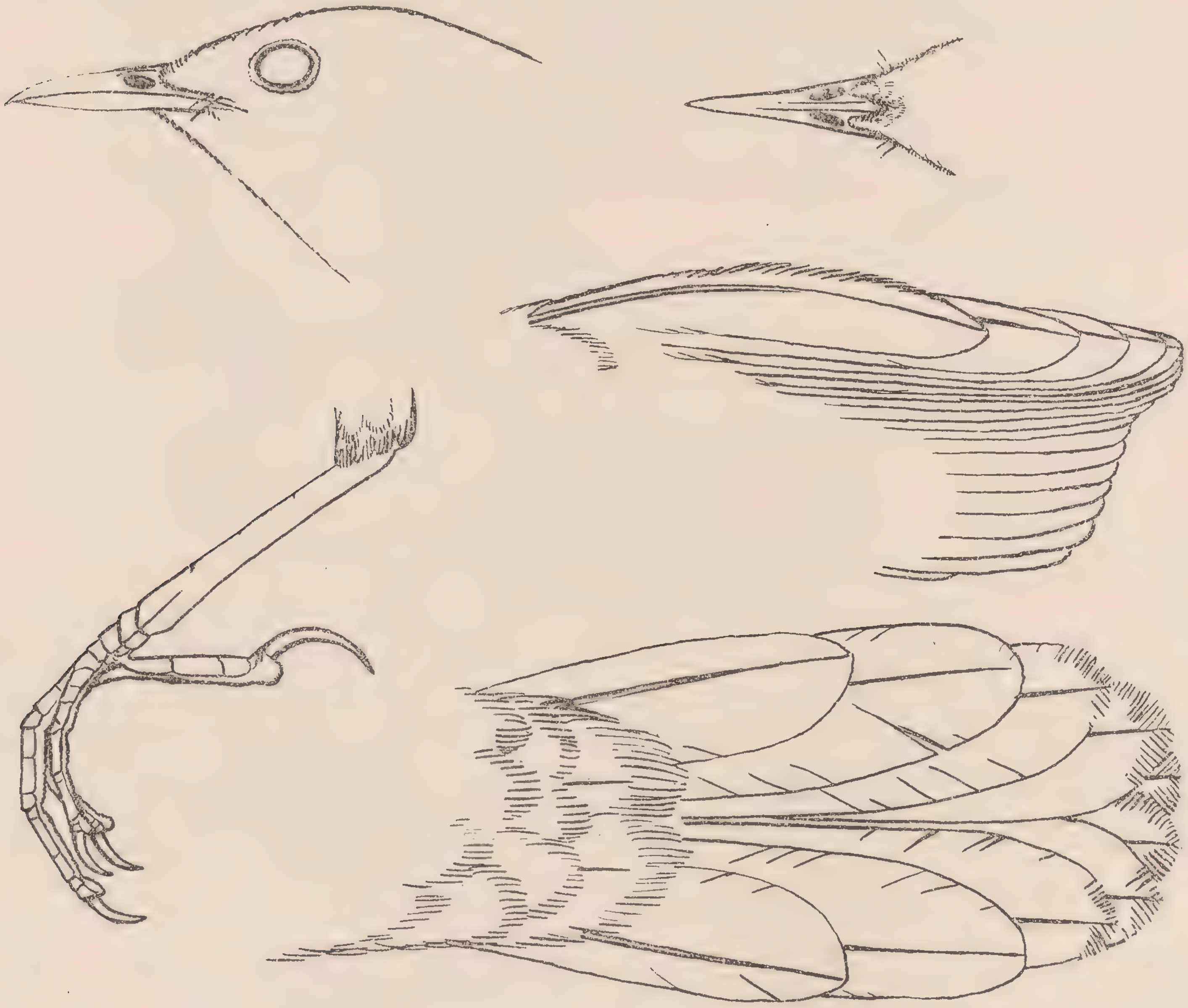

Fig. 4. *Bradyplerus carpalis.* Natural size.

Outermost (10th) primary about $\frac{3}{4}$ as long as 9th, 4th to 6th longest; tail very much rounded, outermost feathers 26 mm. shorter than median.

Length (skin) 165 mm.; wing, 71; tail, 75; bill (culmen to base), 17; exposed culmen, 15; metatarsus, 28; middle toe and claw, 26.5.

Iris dark brown; bill mostly black, but bluish gray beneath mandible; feet brownish.

Adult Female (No. 3204, Faradje, Sept. 11, 1911). Very similar in color to male, but tips of middle wing-coverts and under tail-coverts a little browner. Smaller; wing, 67; tail, 67; bill (culmen to base), 16.5; metatarsus, 26; middle toe and claw, 25.

Remarks.— During the rainy season, in the papyrus-swamps of the region about Faradje, the loud guttural notes of a brown reed-warbler of the genus *Calamocichla* are heard on all sides, particularly in the early morning, mingling with the calls of many other birds, Warblers, Weavers, and even Rails; but probably the most puzzling sound is a succession of chirping notes, of peculiar resonant quality, which start slowly, then quickening and dying gradually away, often to be followed by four or five loud explosive wing-beats. The authors are exceedingly difficult to observe, keeping always under cover of the papyrus, which may be fifteen feet high, and retiring in silence at the first alarm to the lower tangle of old dry papyrus, saw-grass and other vegetation which often fills such swamps waist-high.

It required many an hour of hot and tedious effort, wading, breaking pathways, and waiting motionless, before I could finally ascertain that these noises were made by two species of *Bradypterus;* the louder ones, audible often to a distance of several hundred yards, by the present species; and similar but lower ones by a smaller, lighter-colored form of the *B. brachypterus* group. Neither bird was ever observed away from the papyrus, and of the larger form, the subject of the present description, only five specimens in all could be secured; some of them being shot at a distance of only four yards as they stole about in the dense vegetation. Though less often heard in the dry season, they are nevertheless resident in these swamps throughout the year, and apparently breed toward the month of September.

59.84,3P(26.9)

Article IV.— NOTES ON AMERICAN SUBANTARCTIC CORMORANTS.

By Robert Cushman Murphy.

CONTENTS.

	Page.
Introduction	31
Phalacrocorax atriceps	33
Phalacrocorax albiventer	33
Phalacrocorax georgianus	34
The Shag of the South Orkneys	39
Notes on the Life History of *Phalacrocorax georgianus*	39
Literature	48

Introduction.

The material upon which the present paper is based includes seventeen specimens of the "blue-eyed shag" of South Georgia, collected by the writer, five skins of *Phalacrocorax atriceps* taken by Mr. R. H. Beck at Corral, Chile, and one skin of *Phalacrocorax albiventer* from Patagonia. The South Georgia birds are in the collections of the Brooklyn Museum and the American Museum of Natural History; the Chilean birds belong to the Brewster-Sanford collection in the American Museum; and the skin of *P. albiventer* is number 7911 in the ornithological collection of Princeton University.[1] Curiously enough, all of the adult birds in this assemblage, including the Patagonian and Chilean specimens and five of those from South Georgia, are females. These eleven wholly comparable skins of full-grown cormorants of the same sex have been studied with relation to the status of several species as expressed in the literature since 1898.

Up to the present, two species of cormorants having blue eyelids and entirely white under surfaces, have been recognized as inhabiting the southern extremity of South America and the outlying Subantarctic region. They are:

1. *Phalacrocorax atriceps* King, of the Chilean coast from Puerto de

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[1] To Dr. Leonard C. Sanford of New Haven, and Dr. Charles F. Silvester of Princeton, I am indebted for the loan of specimens.

Corral southward, the Straits of Magellan and Fuegian waters, and the Patagonian side of the continent as far north as the mouth of the Rio Santa Cruz; this species is moreover reputed to be the cormorant of South Georgia and the South Orkneys (*vide infra*).

2. *Phalacrocorax albiventer* (Lesson), inhabiting the Falkland Islands, Fuegia, the Straits of Magellan, and the coast of Patagonia north to Port San Julian.

These two species are closely related but the adults are readily distinguishable by at least two characters that are pronounced and constant. In *atriceps* the caruncles at the base of the bill are always undeveloped, forming no excrescence, and the white plumage of the throat extends upward on the side of the head so as to cover the auricular region. In *albiventer*, on the other hand, the double caruncles attain a large size in the adult, forming two prominent, tuberculated, brightly-colored growths, while the dark plumage of the pileum extends downward over the greater part of the cheek, making a larger "cap" than that of *atriceps*. Ogilvie-Grant (3) as well as Scott and Sharpe (10) illustrate these differences by text figures.

According to Ogilvie-Grant, *albiventer* always lacks the white dorsal patch which is so conspicuous a feature of many specimens of *atriceps*. This is, however, a matter of serious doubt. The presence or absence of a dorsal patch in the white-breasted cormorants has been often misinterpreted. It is properly to be considered not as a permanent marking but as a nuptial or *post-nuptial*, perhaps inconstant, decoration of certain mature birds. In a key to several of the white-breasted cormorants, Sclater (1) groups *Phalacrocorax carunculatus* under the section "*Dorsi fascia nulla*," but this species is now known to have a well-marked white patch at some seasons. Of the five skins of typical *atriceps* in the Brewster-Sanford collection, only one shows a trace of the patch, and in this single instance it is indicated merely by a few new white feathers amid the dark plumage above the rump. It is noteworthy that none of my photographs of breeding South Georgia birds shows the patch. After the end of the breeding season, however, I saw in the same localities many living shags emblazoned with the striking mark. The 'Scotia' photographs (6, 7, 8, 9) of cormorant colonies at the South Orkneys reveal the dorsal surfaces of many birds, and the white patch appears to be missing about as often as it is present. It is therefore surely not improbable that further collection will demonstrate that *Phalacrocorax albiventer* agrees with its closely related circumpolar congeners *atriceps*, *carunculatus*, *onslowi*, etc., in the occasional presence of the patch. At any rate, the entire absence of this feature in some fully mature, breeding South Georgia shags demonstrates its untrustworthiness as a diagnostic character.[1]

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[1] In this I disagree with Forbes (2).

Phalacrocorax atriceps *King.*

Phalacrocorax atriceps King, Zool. Journ., IV, 1829, p. 102.
Type locality, Straits of Magellan.

Measurements in millimeters of the five specimens in the Brewster-Sanford collection are as follows:

Brewster-Sanford Coll. Corral, Chile	Culmen	Bill		Tarsus	Toe and claw	Wing	Tail
		from gape	depth to cutting edge				
1496 ♀, Sept. 17, 1913	60	87	8	63	101	255	112
1497 ♀, Oct. 6, “	56	86	9	64	97	272	116
1498 ♀, Oct. 8, “	59	86	8	66	100	267	112
1499 ♀, Oct. 8, “	58	89	8	63	99	260	110
1500 ♀, Oct. 10, “	60	88	9	67	101	270	123

These figures agree with the dimensions for the species given in the Catalogue of Birds and the Princeton Patagonia Report, except that the wings and tails of the Brewster-Sanford specimens are somewhat shorter through wear. It should be emphasized that lengths of wing and tail are the least useful of measurements unless the series of birds includes examples taken at various seasons of the year. According to Mr. Beck's careful notations on the labels, the ovaries of the specimen taken on October 10, are distinctly larger than those of the September bird. Additional facts recorded by the collector are that the eyelids were blue in life, the iris brown, the gular pouch yellowish (this is also clearly indicated in the dried skins), and that the feet varied from "whitish" to "pinkish flesh color." According to the literature, the irides of this shag become bright green during the breeding season. Darwin is said to be the authority for the statement that the tarsi of adult breeding birds are "scarlet."

The Brewster-Sanford specimens agree well with the colored plate of this species, designated as *Phalacrocorax imperialis,* in the Challenger Reports (1).

Phalacrocorax albiventer (*Lesson*).

Carbo albiventer Lesson, Traité d'Orn., 1831, p. 604.
Type locality, Falkland Islands.

The Princeton University specimen of *Phalacrocorax albiventer* has been fully described by Scott and Sharpe (10). At a glance it is obvious that this bird and the shag of South Georgia have closer affinities with one another than either has with *atriceps*. The striking characteristics of the Princeton specimen are its recurved crest, which is 52 mm. in length and composed of forty or more feathers, its large caruncles, and yellow legs and feet.

P.U. O. C. 7911 ♀ ad.	Culmen	Bill		Tarsus	Toe and claw	Wing	Tail
		from gape	depth to cutting edge				
Near Coy Inlet, Patagonia. Sept. 14, 1896	54	77	9	65	100	274	123

Further remarks concerning this and the preceding species will be made below.

Phalacrocorax georgianus *Lönnberg.*

Phalacrocorax atriceps georgianus Lönnberg, Kungl. Svensk. Vetens. Akad. Handl., XL, 5, 1906, p. 69.

Type locality, Island of South Georgia.

A. M. N. H. & Brook. Mus. Colls., South Georgia	Culmen	Bill		Tarsus	Toe and claw	Wing	Tail
		from gape	depth of cutting edge				
R. C. M. 1574 ♀ ad. br. Dec. 23, 1912	49	72	8	64	103	276	119
" 1648 ♀ ad. br. Dec. 30, 1912	50	70	8	61	100	278	117
" 1654 ♀ ad. br. Dec. 30, 1912	51	75	7.5	62	101	278	122
" 1840 ♀ ad. br. Feb. 16, 1913	48	71	8	63	104	273	119
" 1841 ♀ ad. br. Feb. 16, 1913	44	70	8	—	—	270	116

Ogilvie-Grant (3), p. 392, described the skin of a nearly adult cormorant from South Georgia, and tentatively referred the specimen to *Phalacrocorax atriceps*. At the same time, however, he called attention to the short bill and other features in which it seemed to differ from typical *atriceps*, and suggested that this insular form might prove to be distinct.

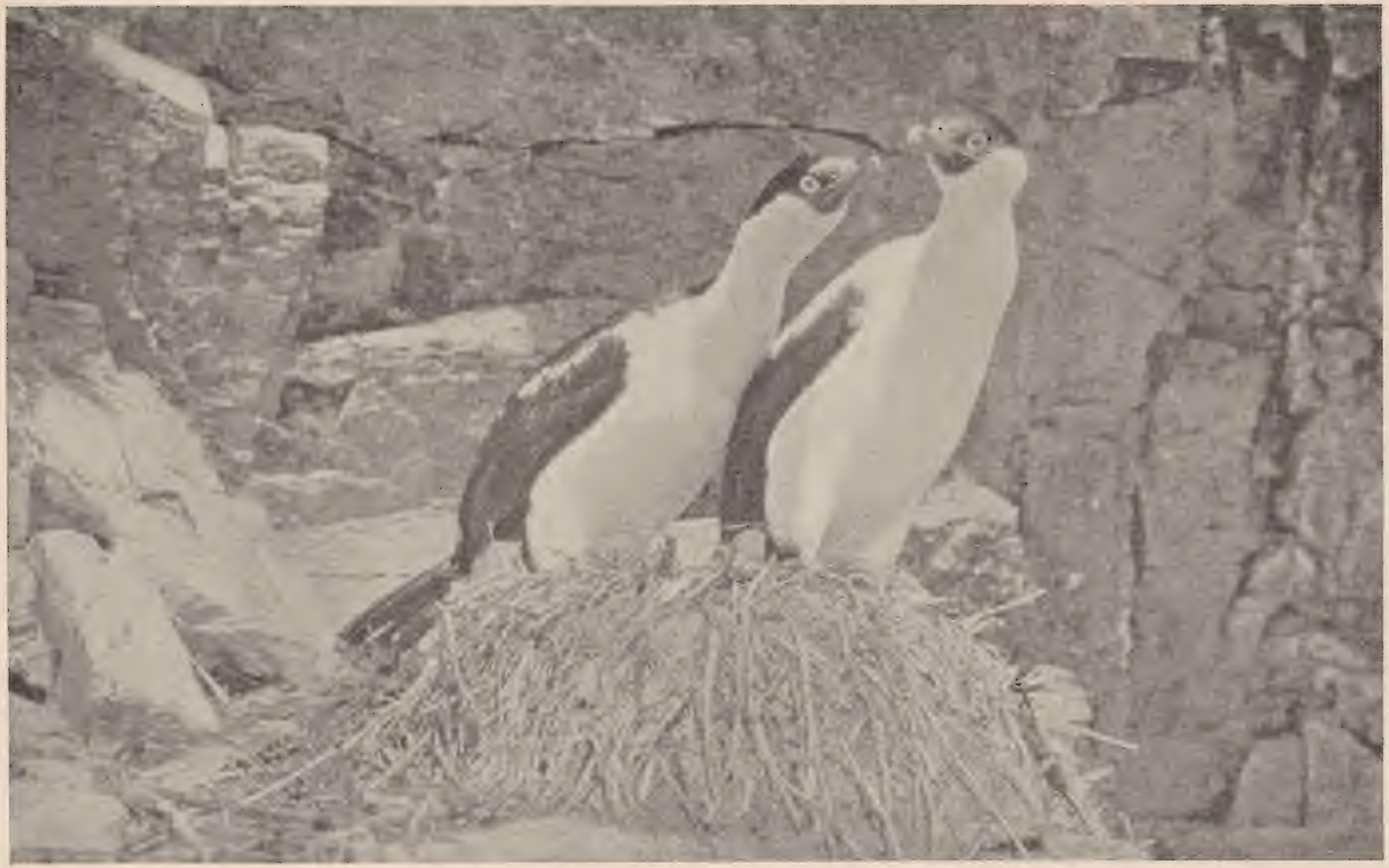


Fig. 1. *Phalacrocorax georgianus.* A courting pair. Dec. 29, 1912.

Eight years later Lönnberg (5) studied four additional South Georgia cormorant skins, three of which were of young birds, and, on the basis of a single adult male, proposed with some hesitation the name *Phalacrocorax atriceps georgianus.* Lönnberg gave a satisfactory description of the type, and by extending the application of Ogilvie-Grant's key (p. 339 of the Catalogue), which is based on the position of the line of demarcation between black and white plumage on the side of the head, he showed that in the South Georgia shag this boundary crosses the ear opening, whereas the ear of *atriceps* is in the midst of white plumage, and the ear of *albiventer* in the midst of black. This diagnostic difference holds good for the eleven adult specimens which I have examined.

Lönnberg apparently had no material with which to compare his adult South Georgia bird, and so he based his subspecies upon Ogilvie-Grant's description of *atriceps.* A critical examination of the skins before me, however, shows that *georgianus* is in fact undoubtedly closer to *albiventer* than to *atriceps,* though not without unique characters of its own. As regards the borderline of white and black on the side of the head, the bird might be considered intermediate between the other two, but in the possession of prominent caruncles and a long crest it agrees entirely with *albiventer.* It may be added that from *à priori* considerations the shag of South Georgia might reasonably be expected to show greater affinities with a Falkland Islands form rather than with the chiefly, or perhaps wholly, continental *atriceps.* The status of the South Orkney cormorant, which has been referred to the species *atriceps,* will be discussed below.

Averaged measurements of examples of the three forms are as follows:

	Culmen	Bill		Tarsus	Toe and claw	Wing	Tail
		from gape	depth to cutting edge				
P. atriceps 5 adult ♀ ♀	58.6	87.2	8.4	64.6	99.6	264.8	114.6
P. albiventer 1 adult ♀	54	77	9	65	100	274	123
P. georgianus 5 adult ♀ ♀	48.4	71.6	7.9	62.5	102	275	118.6

As regards measurements, therefore, it appears that *Phalacrocorax georgianus* differs from its two congeners mainly in that it has a much shorter bill. This character distinguishes the South Georgia bird particularly from *atriceps,* for of the five adult females of each species which I have examined the length from tip to gape of the longest *georgianus* bill is 11 mm. shorter than the shortest *atriceps* bill. The average difference in length, as indicated by the table, amounts to 25 mm. Bills of adult males would doubtless prove considerably longer in all three species, and for this reason their measurements should not be compared with the present figures.

A study of the whole group of white-breasted cormorants, including the forms representative of the Indian Ocean and the New Zealand Subantarctic region, is much needed to throw further light on the origin and relationships of these birds. It is probable that several now recognized as species might then be shown to differ only subspecifically from the form nearest the parental stem. In the meantime it is not practicable for me to indicate precise relationships, even between birds having as much in common as *albiventer* and *georgianus,* especially since the latter has already been grouped by two authorities with *atriceps.* Comparative notes regarding the three American Subantarctic forms are tabulated below, but many of these data need confirmation and extension from field observations.

	atriceps	*albiventer*	*georgianus*
Max. length of crest	43 mm. (October) Brewster-Sanford skin.	52 mm. (September) Princeton Univ. skin.	"50–60 mm." (August) 46 mm. (December)
Caruncles	Small, practically no excrescence; yellowish or greenish.	Strongly developed; deep yellow.	Strongly developed; deep yellow.
Gular pouch	Yellowish (October) Yellowish-green (February)	?	Blackish-brown (December)
Iris	Green (February). Brownish except during breeding season.	"Green in breeding season; at other times yellowish brown."	Brown (Nov., Dec., Jan., Aug.)
Feet and legs	Flesh color (October). "Scarlet"	Cadmium yellow. (September)	Pale salmon color (December)
Dorsal white patch	Sometimes present.	Said to be lacking.	Sometimes present.
Max. length of white alar bar	100 mm.	93 mm.	120 mm.

Description of Phalacrocorax georgianus.

Adult breeding female. Upper surface black, with metallic green, blue, and violet sheen. The luster is dull violet on the occiput and neck; green-blue on the forehead and crest; dusky blue on the middle line of back, the rump and the flanks; rich, dark, bottle green on the scapulars and wings. The scapulars, interscapulars, and lesser coverts have a scaled appearance, each green feather bearing a narrow glossy bluish border. Quills of wings and tail blackish brown, with a greenish tinge when fresh; shafts of the rectrices basally white. A white alar bar, composed of lesser coverts, extends along the radial border of the wing for from 8 to 12 cm. Under wing coverts and thighs dusky, with a slight metallic gloss. Entire under surface white, the plumage of the throat projecting in a point onto the gular pouch to a position about under the center of the eye. The line of demarcation between black and white on the side of the head passes squarely from the bare face, just above the gape, and crosses the ear opening. Flesh colors: Iris hair brown, lightening to gray at its periphery; cornea chocolate. Skin about eye cyanine blue. Skin of lores and throat blackish brown. Caruncles deep chrome. Feet and legs pale salmon color; under side of toes clove brown. Dimensions: Length (skin), 620; crest, 46; culmen, from feathers between caruncles, 44–51 (48.4); bill from gape, 70–75 (71.6); depth of bill to cutting edge, 7.5–8 (7.9); tarsus, 61–64 (62.5); outermost toe and claw, 100–104 (102); wing, 270–278 (275); tail, 116–122 (118.6).

Probably the wing, tail, and crest, would prove to be longer at other seasons of the year, when the white dorsal patch might also be present. Adult males are apparently larger in most dimensions, a condition said to be true also of *atriceps* and *albiventer*. Lönnberg's adult male of *georgianus* was taken on August 15 (midwinter). It had prominent caruncles, a crest 5–6 cm. in length, a white dorsal patch broken in the middle line, and the following measurements: culmen, 57; tarsus, 60; outermost toe and claw, 105; wing, 280; tail, 135. Its irides were light brown, like those of my breeding birds.

White filoplumes on the head seem to be present only in young specimens of *georgianus*, and are not, therefore, indicative of breeding plumage, as stated by Ogilvie-Grant (p. 392).

The naked, black, newly hatched young of the South Georgia shag has a pinkish throat pouch, slaty blue mandible, and plumbeous legs and feet. Its appearance and anatomy have been described by Shufeldt (11). After four or five days of growth, tufts of soft, fuscous down begin to appear, covering first the back and the sides of the neck. Simultaneously the remiges and rectrices are indicated by the sprouting of a cluster of bristly plumules from each follicle. Finally, tufts of white down grow out among the darker tufts on belly, throat, and pileum, and the young shag is soon enveloped in a dense covering of prevailingly fuscous, fluffy down, the face alone remaining bare.

In this overcoat the young shag grows for five weeks or more before the down wears off the center of the back, exposing the greenish contour feathers. After seven weeks it is mostly devoid of down except on the head and neck. At this stage the back is grayish brown mingled with green; the position of the alar band is indicated by a line of pale-edged feathers; the breast is white with a few dark flecks; the head and neck are sprinkled with white, broomlike filoplumes and down tufts, especially above and behind the eye; the rectrices have grown to a length of 12 cm. in spite of very active wearing away, but the primaries are still short and fresh.

Of the breeding adults collected, one, No. 1841, is obviously younger than the others, having a smaller bill and caruncles, short crest, and less metallic plumage over the whole dorsal surface. This specimen and one or two of the others illustrate that the quills of wing and tail are shed and renewed in irregular sequence. For instance, in the right wing of No. 1841, the outermost primary and two of the middle secondaries are old, frayed, and faded so that they have no resemblance to the other feathers. These are probably quills of the first plumage. The seventh (second from outermost) primary, and two or three secondaries are perfectly new and very greenish. The remaining quills are older, and slightly faded.

The Shag of the South Orkney Islands.

Clark (9) has identified the shags collected by members of the Scottish National Antarctic Expedition as *Phalacrocorax atriceps*, and has, he believes, settled the question as to the identity of the Antarctic shags which were reported by Ross at Louis Philippe Land and Cockburn Island as long ago as 1844. I have not had an opportunity of seeing a specimen from the South Orkneys, but fortunately many excellent photographs of this bird have been published (6, 7, 8, 9). A comparison of these pictures with the Brewster-Sanford skins, as well as with the figures of Sclater (1), pl. xxv, Ogilvie-Grant (3), p. 391, and Scott and Sharpe (10), p. 518, indicates that the South Orkney bird is not *atriceps*, after all. In the possession of large and prominent caruncles it apparently leans toward *albiventer* and *georgianus*, while in the location of the line of white and dark plumage on the head it also seems to resemble the South Georgia bird.

Notes on the Life History of Phalacrocorax georgianus.

I first saw the blue-eyed shags at sea along the north coast of South Georgia on November 24, 1912. The morning was clear and calm, and the birds were swimming about among small bergs and areas of floe ice. When rising into flight, they kicked heavily along the surface for considerable distances. They flew in string formation, a dozen or more together, and often spread their broad feet to serve as an adjunct to the tail, particularly when stopping headway. Their flight seemed to be more or less aimless, for they travelled in circles, as a rabbit runs.

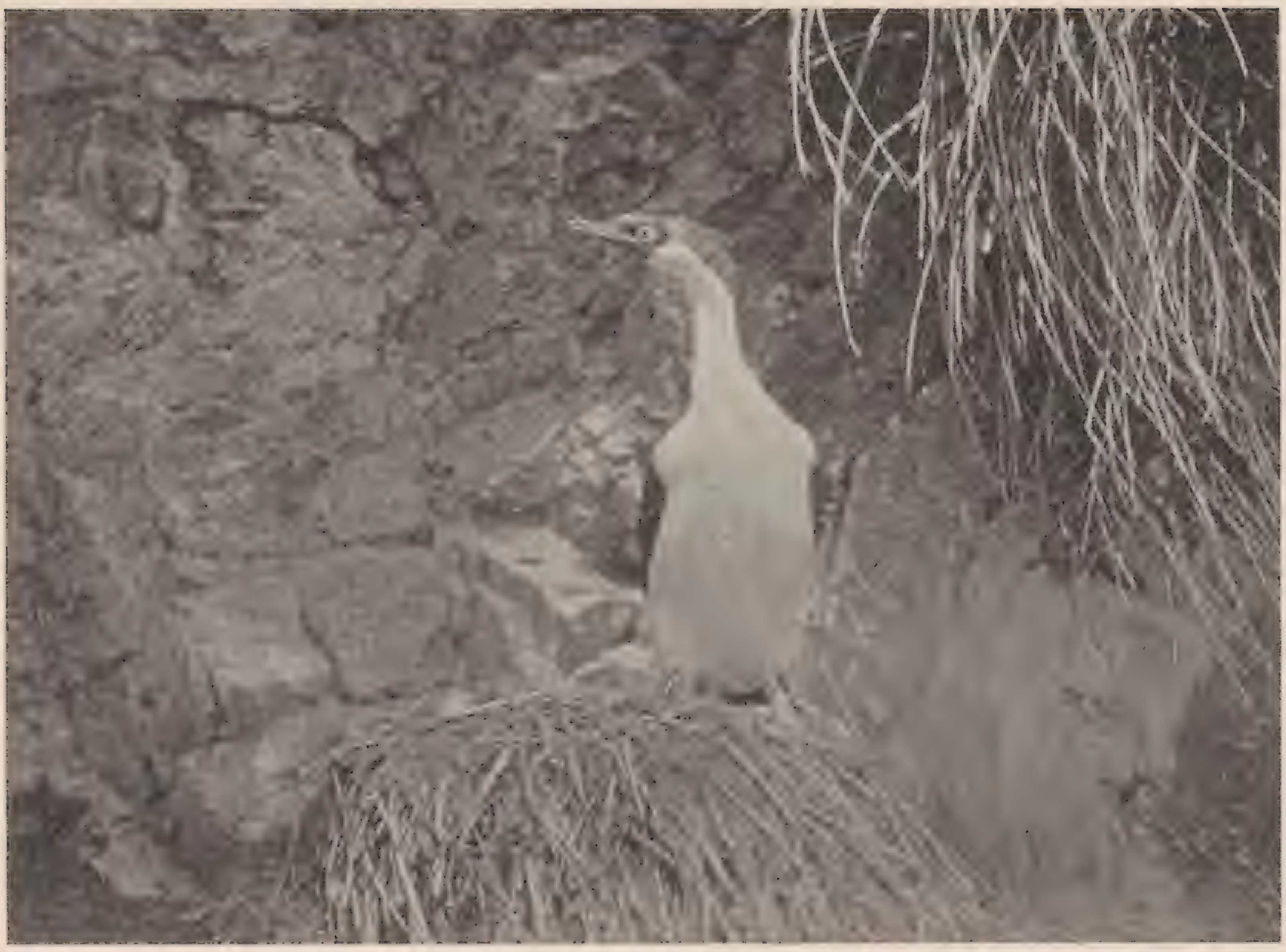
A few days later we found the shags common in Cumberland Bay. Numbers of them frequented some rocks lying off the Moraine Fjord, from which they would dive into the surrounding kelp for fish. I shot one of the birds just as it emerged from such a dive, and incidentally killed and captured the fish whose tail projected from its mouth. It proved to be a species of *Notothenia,* and it measured 27 cm. in length!

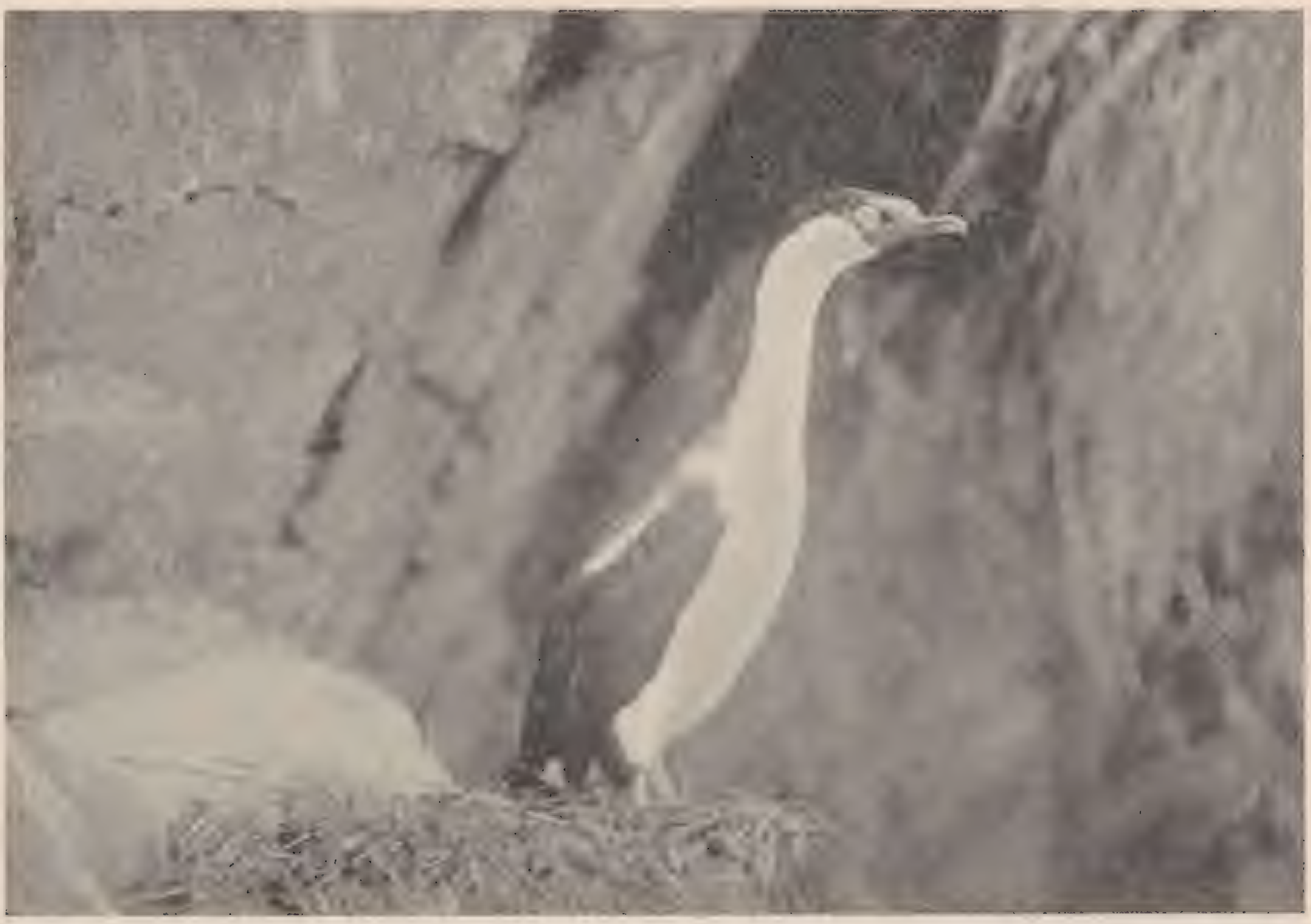
On December 16, 1912, we found the first breeding grounds of the shags on a small precipitous islet lying near the south shore of the Bay of Isles. Here I landed on December 29, and with some difficulty climbed to the top, where the rock proved to be covered with thick black soil and a luxuriant growth of tussock grass. A pair of pipits (*Anthus antarcticus*) inhabited the islet, and also a few whale-birds (*Prion*) to judge by the dismembered skeletons left on the ground by ravenous skua gulls; but the principal residents were the shags whose nests lined the rocky and grassy ledges all over the northerly or sunny face of the islet's declivity.

The nests were steep-sided truncated cones of mud and dead tussock grass, with a rather deep depression. In height they measured 20–25 cm., the diameter at the top being about 40 cm. Some were situated on the tops of dead tussock hummocks, others on the shelves of lichen-covered rock, with long icicles overhanging them. The area around the nests was whitened by the birds' ejecta, squirted to a distance of two meters.

Many nests contained sets of two or three eggs, others young birds just hatched or a few days old, and another held three full-grown fledglings which had lost nearly all their down. Two or three pairs of adults had not yet laid their eggs, and stood on their empty homes carrying on courtship antics which will be described below.

Both parents seemed to be together at all of the nests. I lifted off one female, which had been brooding with her wings spread, and discovered a blind, black, and unclad shaglet, the eggshell from which it had just crawled, and another egg not yet broken open. It was impossible to keep either parent away from the nest, although the male was less brave than his mate. Both were very gentle, not attempting to defend themselves; they merely watched me sharply with their close-set, blue-rimmed eyes. The only note that they uttered was a low croak. They kept their bills parted, however, the mandible and throat trembling violently, just as when one's teeth chatter. When I tossed them aside in order to see the nestling, they would





Figs. 2 and 3. Courtship. The female shag watching the circling male. Dec. 29, 1912.

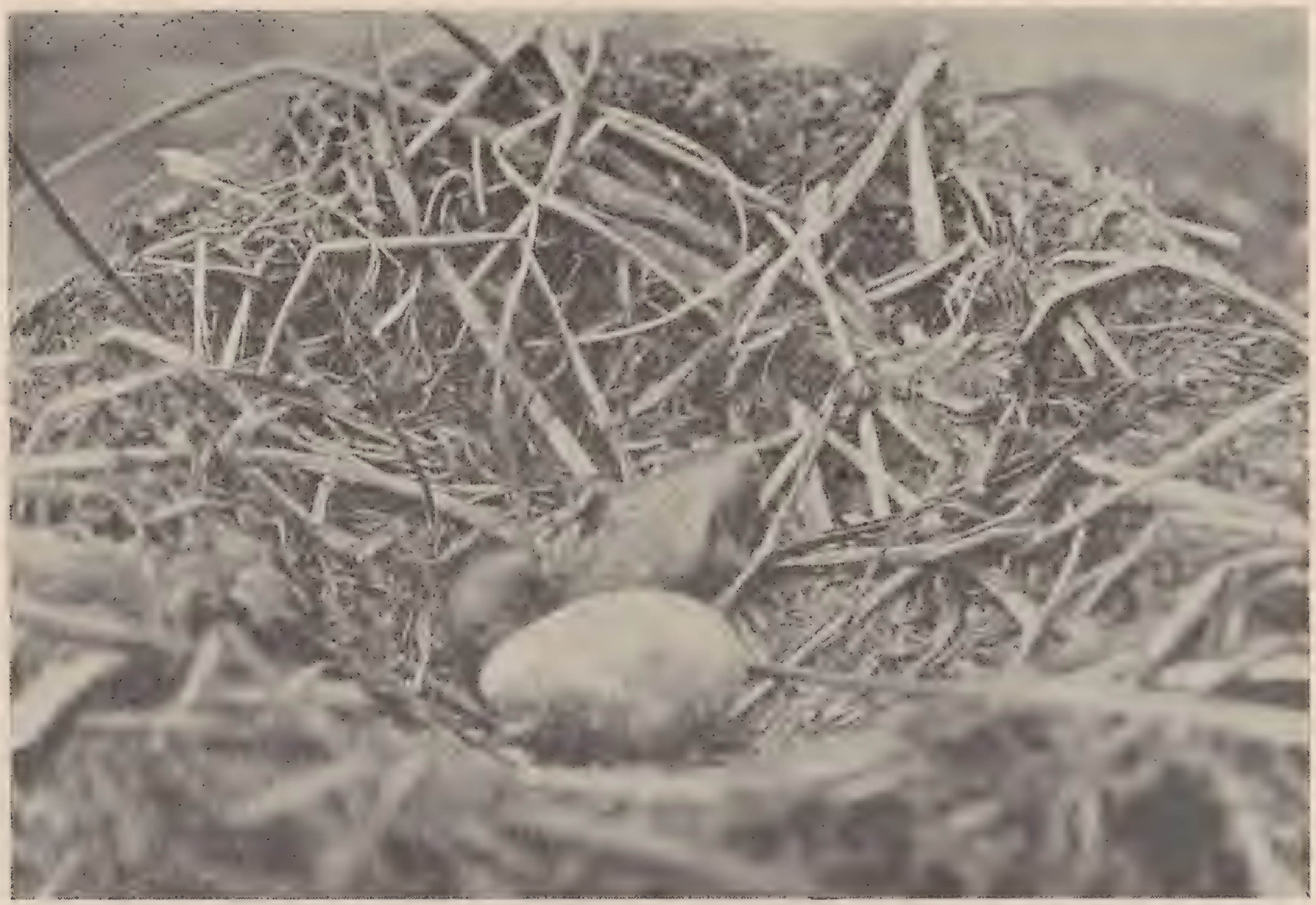


Fig. 4. Egg and newly hatched young. Dec. 29, 1912.

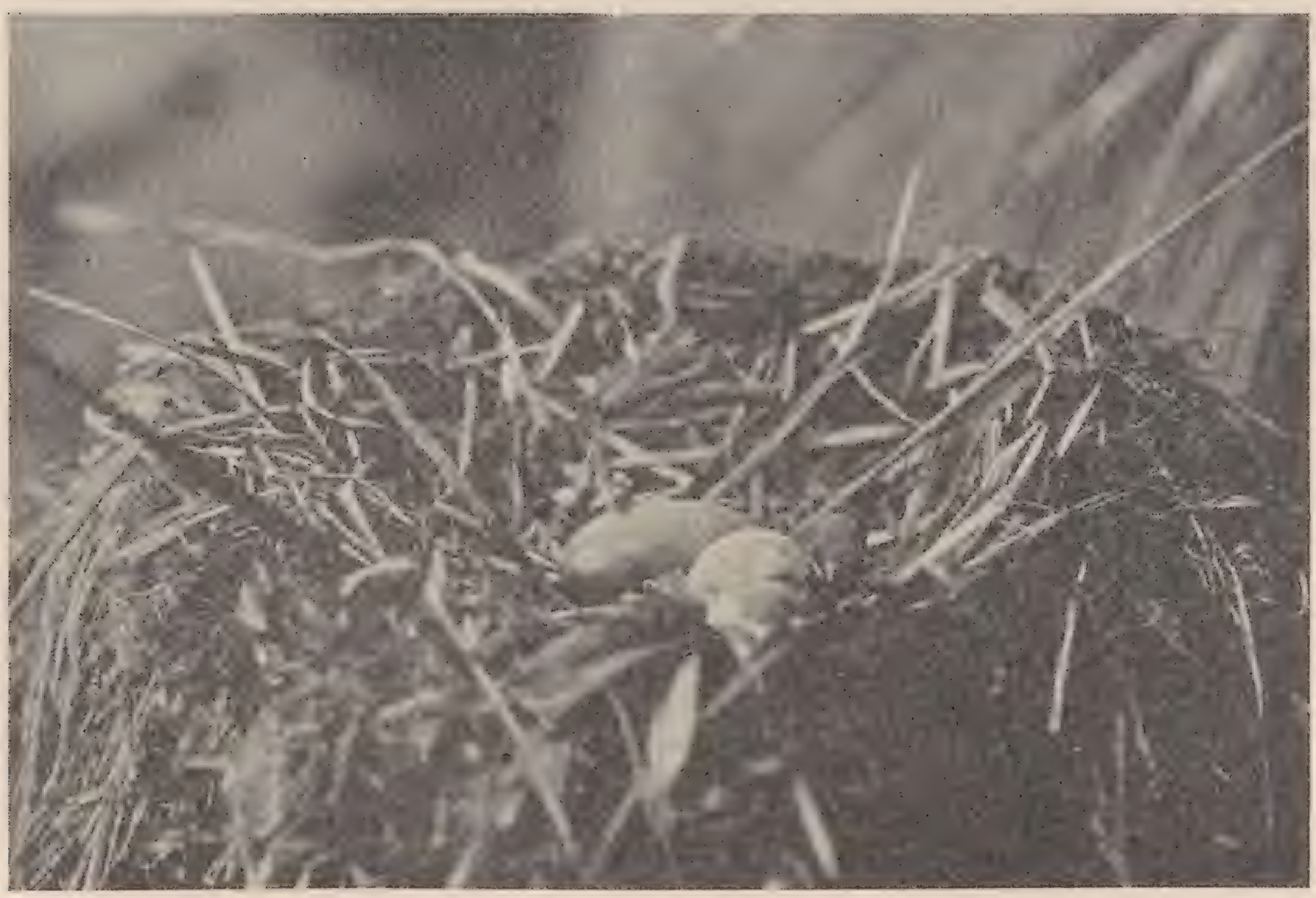


Fig. 5. Two newly hatched young lying characteristically flat on their backs. Dec. 29, 1912.

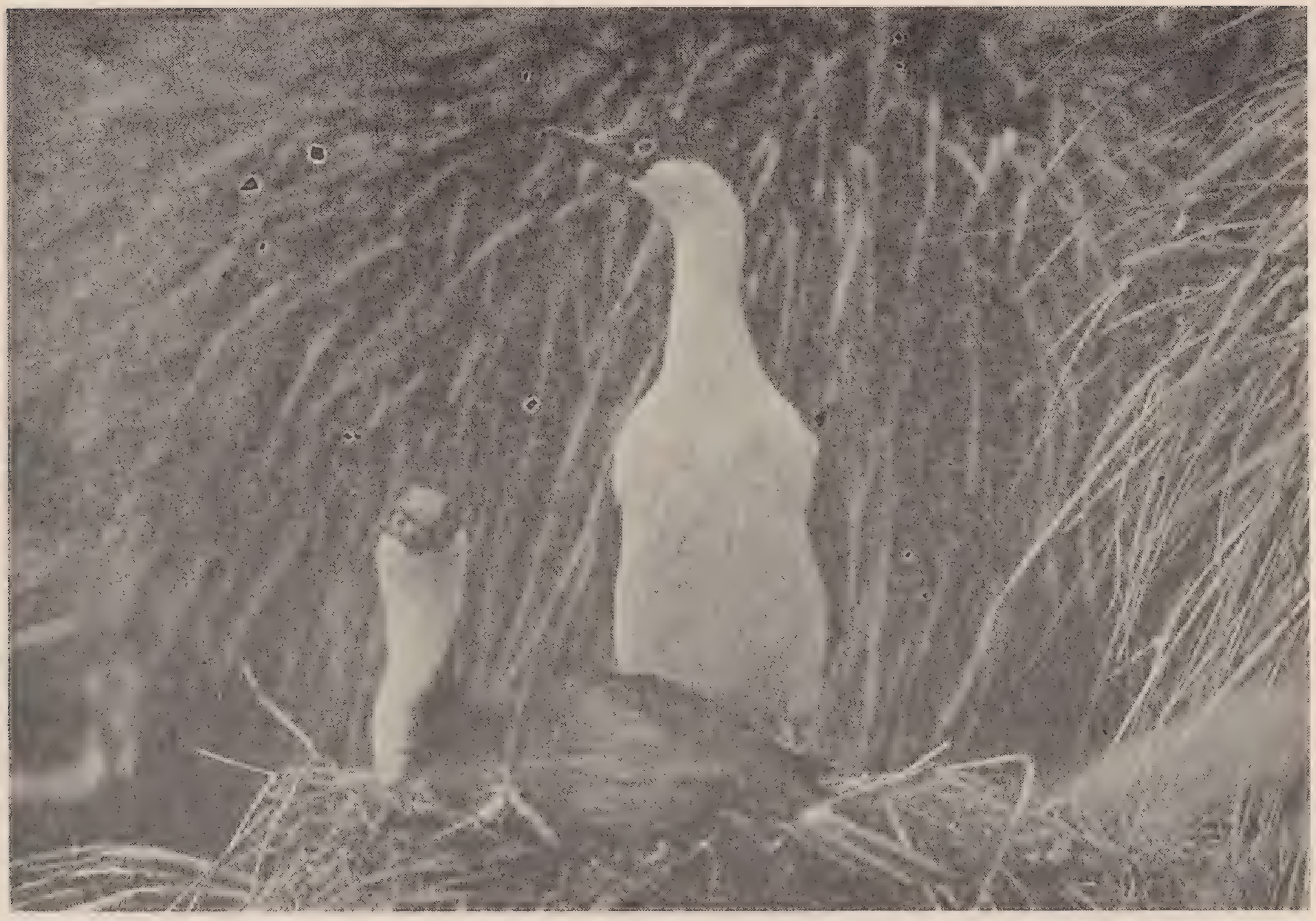


Fig. 6. Pair at the nest. The binocular vision of the sitting female is noteworthy. Dec. 29, 1912.

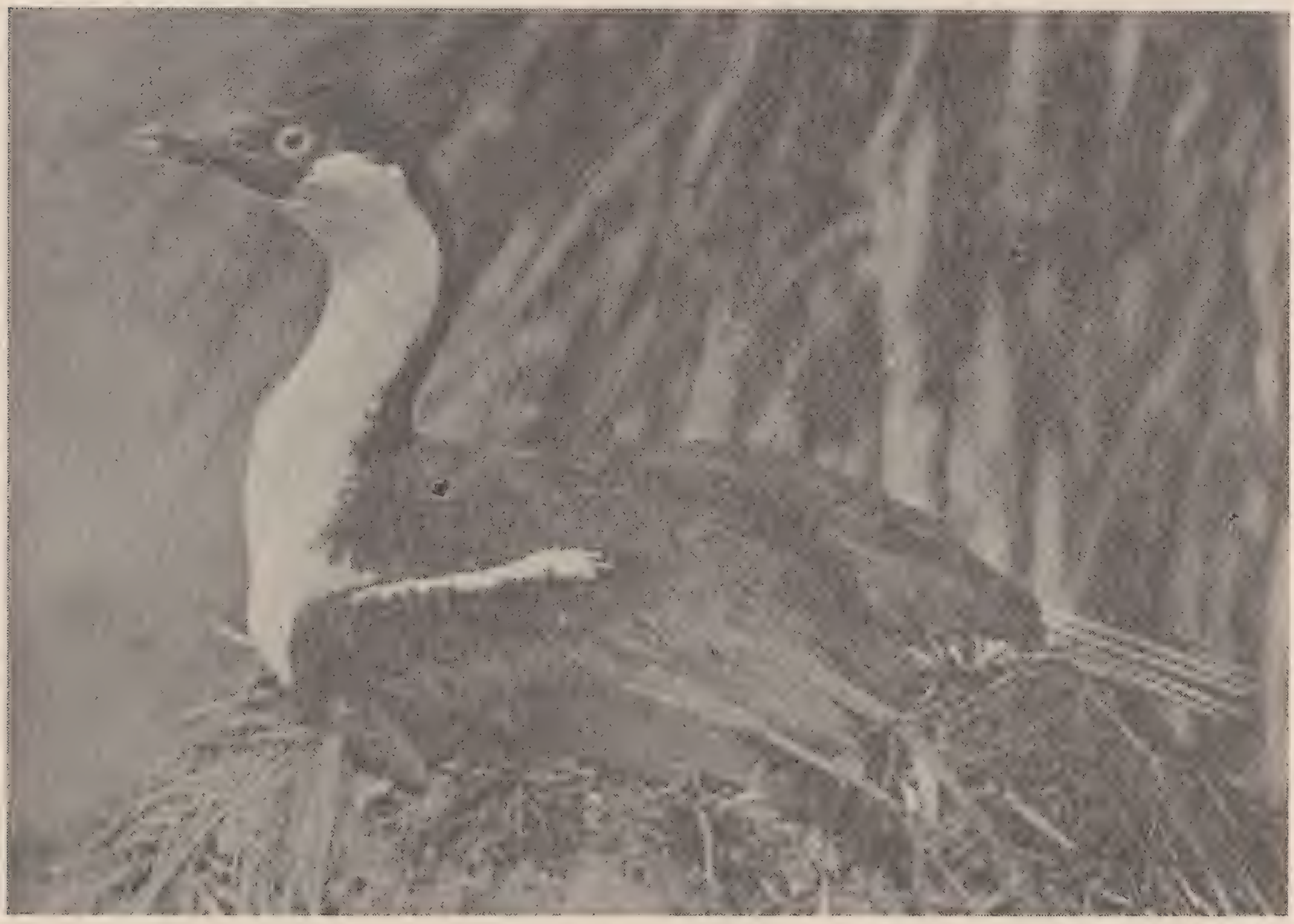
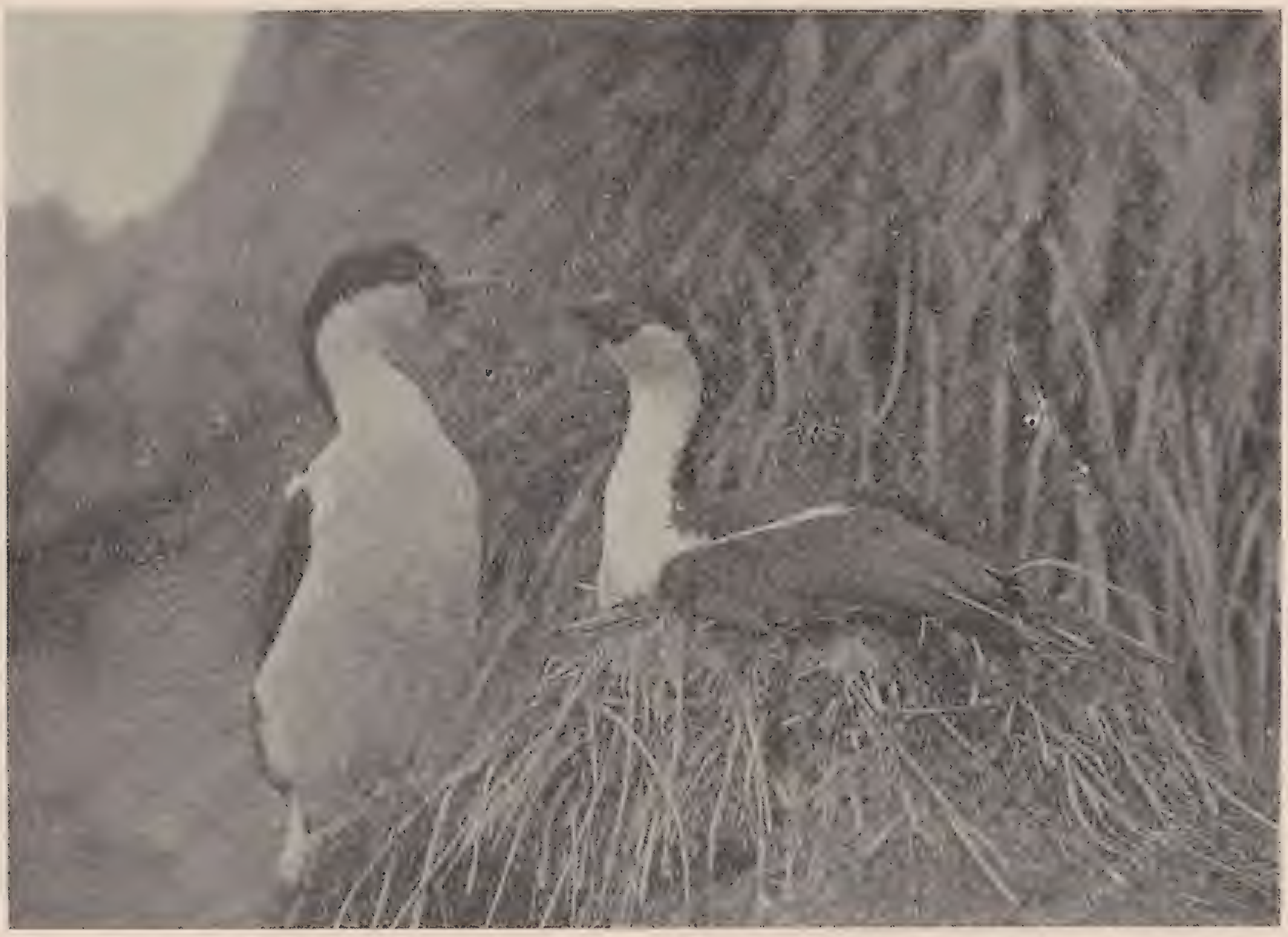
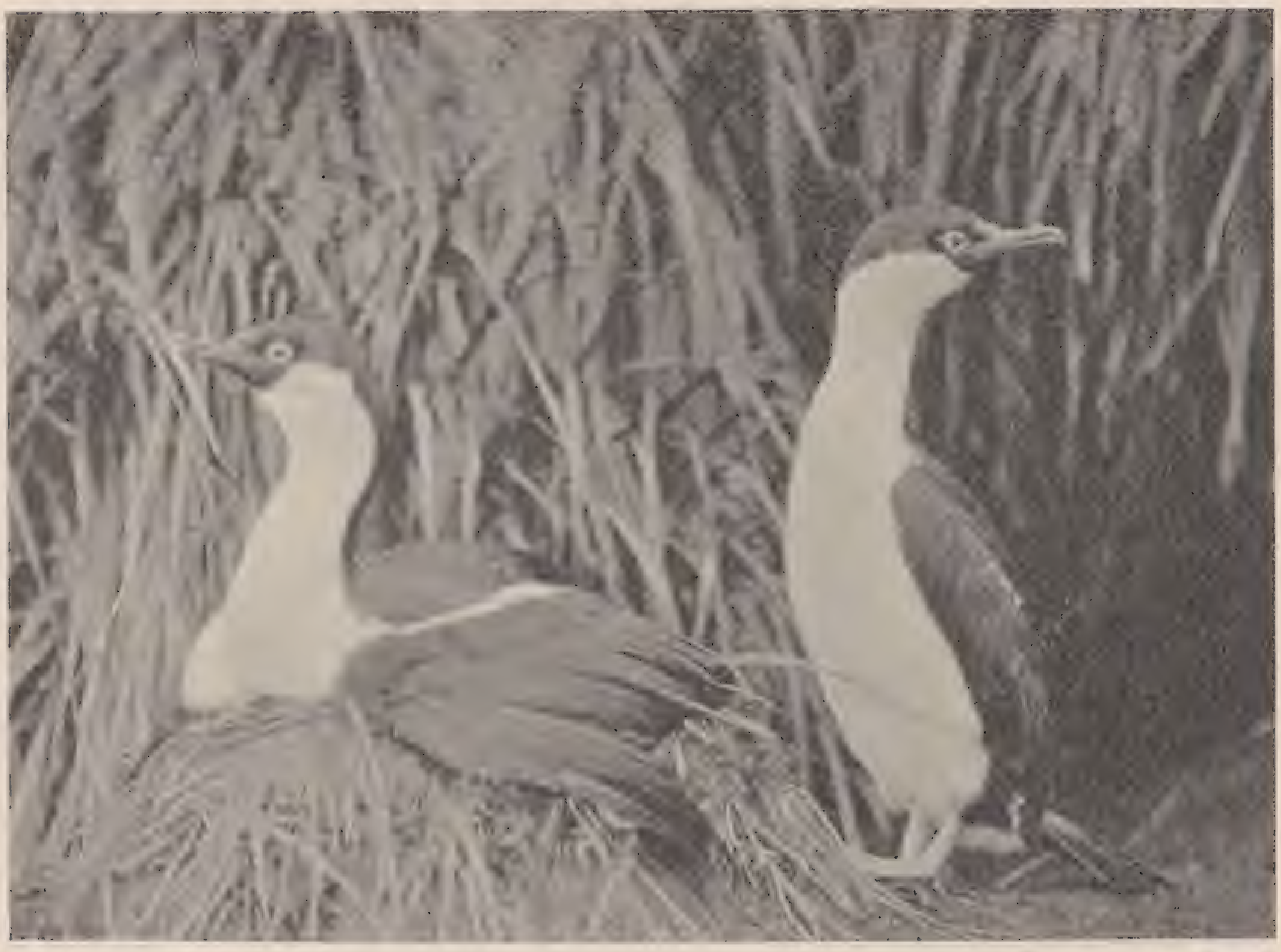


Fig. 7. Female shag brooding young. Dec. 29, 1912.





Figs. 8 and 9. Pair at the nest, the female brooding. Dec. 29, 1912.

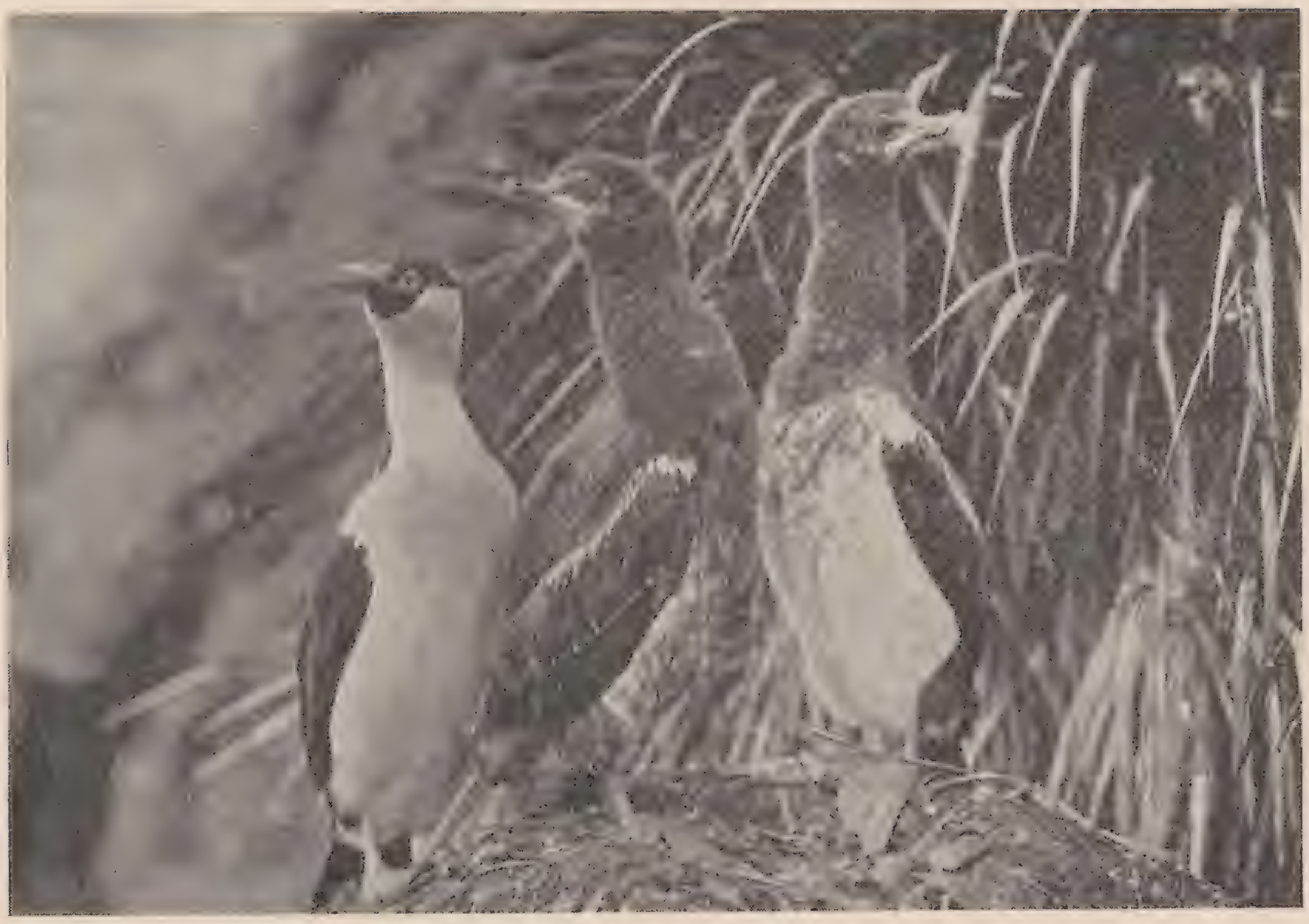


Fig. 10. Female shag with young 49 days old. Feb. 16, 1916. The same young birds are shown in Fig. 5.

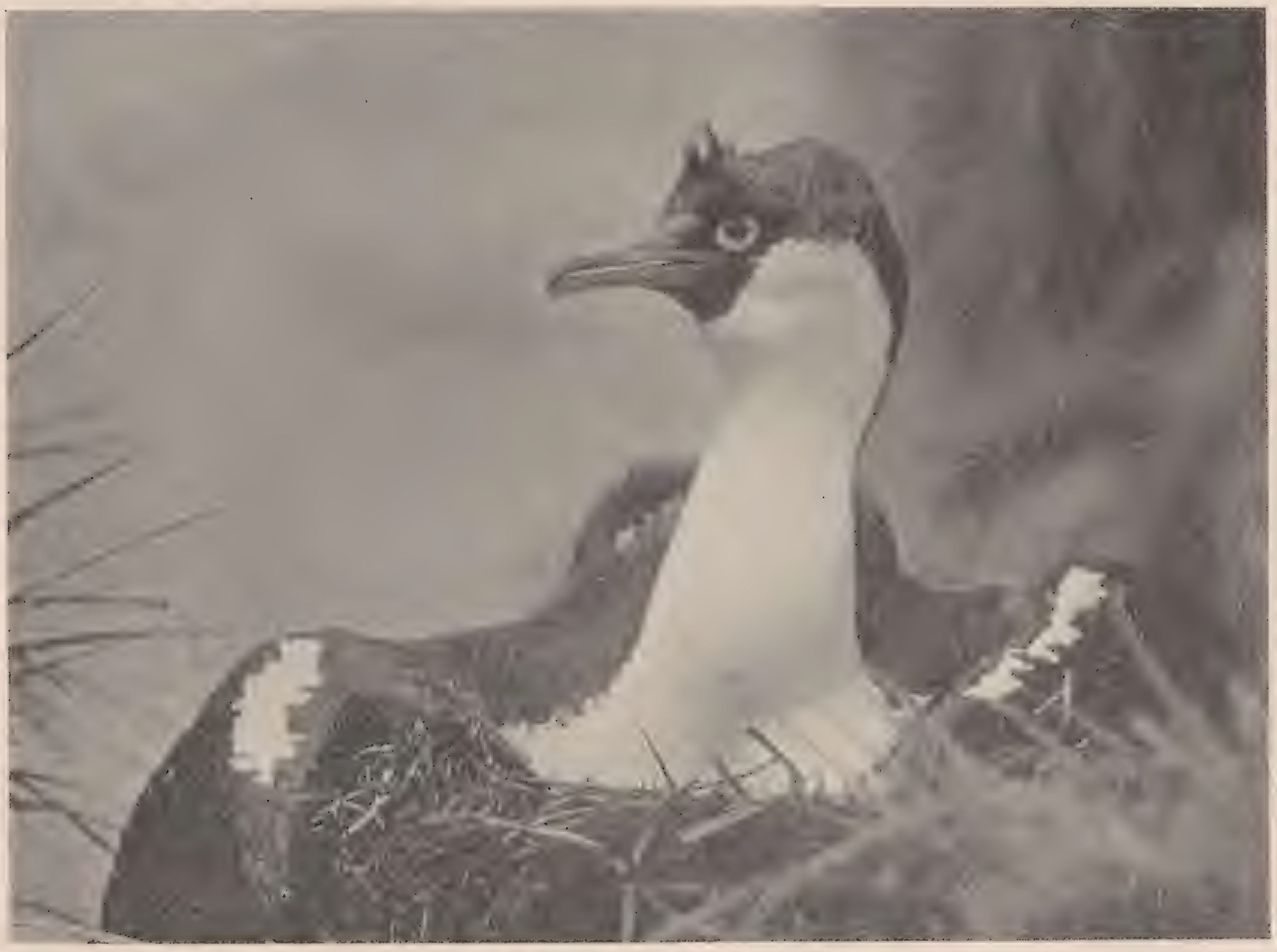
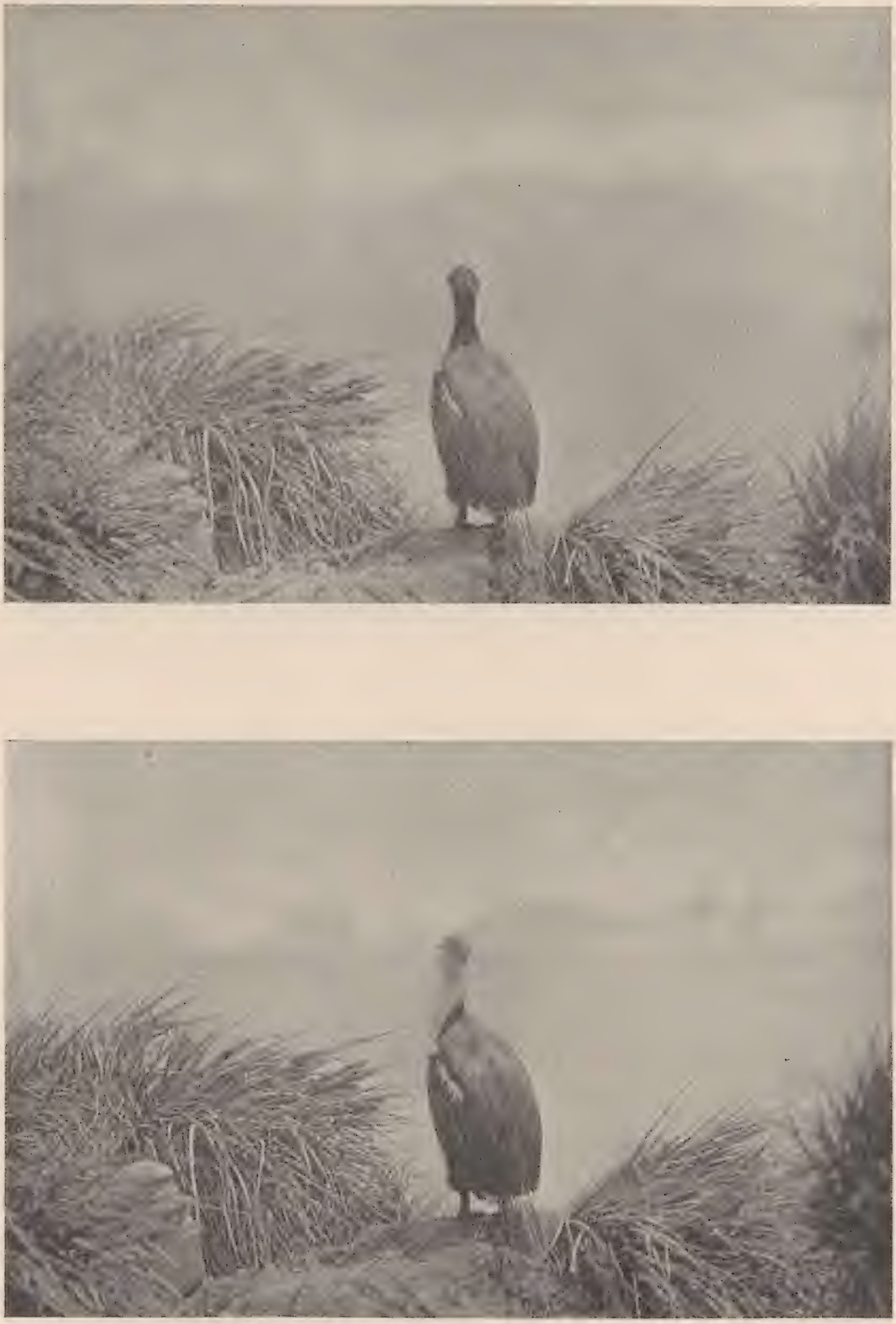


Fig. 11. Brooding female, showing the tremulations of the throat. Dec. 29, 1912.



Figs. 12 and 13. Two views of a shag standing on the brink of a cliff, Dec. 29, 1912. In the second figure the bird has twisted its neck through half a revolution. The vegetation is tussock grass (*Poa flabellata*).

fly back immediately, and the female would plump right into the nest. The ugly baby, the cause of all this solicitude, acted as though it were in a violent temper. Perhaps it was cold. It kicked about so that I could scarcely photograph it, rolling its belly upward, jerking itself around the nest cavity, and all the while squeaking loudly. Even as I stood beside the nest the male parent brought up a billful of fresh peaty soil which he worked into the edge of the structure.

The courtship of the shags seemed to progress while the nests were building. I saw one pair standing side by side, and curtseying. They would put their cheeks close together, bow down their heads and necks, then, twisting their necks, put the other cheeks together in the same way, and curtsey again. After this graceful minuet had been continued for several minutes, the male would launch off on a short exuberant flight, from which it would return to resume the love-making.

A few days later I visited the islet again. The shags were all together in pairs and were twisting and curving their sinuous necks without cessation. Most of the eggs had hatched. I noted again that the females were more unselfish and devoted than the males. I saw one pair attack and bite the neck of a neighbor which had alighted on their particular crag. The courting birds were still bowing, caressing, and circling, besides which they sometimes stretched up and beat their wings rapidly, without producing any drumming sound.

I found that the necks of the shags were infested with a species of tick (*Ceratixodes putus* Cambr.), the bag of which was about 6 mm. in length. Five such were among the blue feathers on the neck of one female bird.

On January 11, 1913, I made a third visit to the colony. The two young shags which had hatched on December 29 and 30 were now well covered with tufts of black feathers, but they still showed a slight difference in size. I found one set of three fresh eggs; another nest contained two newly hatched young and an addled egg. The parents were braver than ever, especially the females, which clung tenaciously to the nests, their mandibles trembling as they watched me. They allowed me to stroke their backs without moving, but the males always stood on the far side of their mates so as to avoid possible danger. I offered a small dead fish to one pair. It was accepted immediately, but was dropped again, doubtless because it was stale.

I did not land at the islet again until February 16, when most of the youngsters had begun to acquire greenish quills and white breasts, and were wandering away from the nests among the high tussock hummocks. They had a low, mellow whistle which they repeated over and over, swelling out their throats. The breeding ledges were foul with decayed fish remains and excreta. The parents were rather less confident than when the young were more helpless, but the females as usual showed less timidity than the males.

On March 2 we found a small, inaccessible shag colony on the face of a cliff in Possession Bay, and the adults were still caressing and curtseying on some of the nests.

The few eggs collected are of a characteristic light greenish-blue ("pale dull glaucous blue" of Ridgway's 'Color Standards and Nomenclature,' 1912), with a chalky encrustation. Unfortunately they have been broken so that it is impossible to make satisfactory measurements.

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Article V.—THE PROPER GENERIC NAME OF THE MACAQUES.

By J. A. Allen.

Recently in the 'Proceedings' of the Biological Society of Washington[1] Dr. M. W. Lyon, Jr., showed conclusively that the name *Pithecus* Geoffroy and Cuvier (1795), adopted by the late Dr. D. G. Elliot in his 'Review of the Primates'[2] was untenable as a generic name, being indeterminate. Lyon concludes with the statement: "Hence *Pithecus* must be dropped as the technical name of the macaques and the more familiar *Macaca* be restored."

For nearly a century *Macaca* Lacépède, 1799, has been the commonly recognized name of the macaques, usually taken, however, from Desmarest (1820) with the original spelling modified to *Macacus*. In early days the Barbary ape (*Simia sylvanus* Linné, 1758 = *Simia inuus* Linné, 1766) was included in *Macacus*, and some taxonomers still question the necessity of separating it generically from the other macaques. It happens that the Barbary ape (*Simia inuus* Linné, 1766) was the only species mentioned under *Macaca* by the founders of the genus, and this species is therefore the genotype of *Macaca*.

It has recently been decided, on the principle of tautonymy,[3] that the type of the Linnean genus *Simia* is *Simia sylvanus* Linné, an earlier name for *Simia inuus*, the type of *Macaca*. It becomes necessary, therefore, to determine which name among the score of generic and subgeneric names that have been bestowed upon the various species of the genus *Macaca* is tenable to replace *Macaca* as usually accepted. The Barbary ape proves to be the type of many of them, as shown by the following summary:

1758. *Simia* Linné, Syst. Nat., 10th ed., I, 1758, p. 25.
Type, by tautonymy, *Simia sylvanus* Linné, 1758 = *Simia inuus* Linné, 1766. *Cf.* Thomas, Proc. Zool. Soc. London, 1911, p. 125.

1799. *Macaca* Lacépède, Tabl. Mamm., 1799, p. 4.
Type, by monotypy, *Simia inuus* Linné = *Simia sylvanus* Linné.

1812. *Inuus* Geoffroy, Ann. Mus. Hist. Nat. Paris, XIX, 1812, p. 100.
Type, *Inuus ecaudatus* Geoffroy = *Simia inuus* Linné.

1816. *Sylvanus* Oken, Lehrb. Naturg., Theil 3, Zool., Abth. 2, 1816, p. 1223.
New name to replace *Inuus* Geoffroy. Also preoccupied by *Sylvanus* Latreille, 1807, for a genus of insects.

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[1] Proc. Biol. Soc. Washington, XXVIII, p. 179, Nov. 29, 1915.

[2] Review of the Primates, II, pp. xxxii, 176, 1912 (June, 1913).

[3] *Cf.* Thomas, Proc. Zool. Soc. London, 1911, p. 125, March, 1911.

1820. *Macacus* Desmarest, Mamm., I, 1820, p. 63.
Emendation of *Macaca* Lacépède, 1799.

1827. *Magus* Lesson, Man. Mamm., 1827, p. 43.
Contained originally two species, *Magus sylvanus* (Linné) and *M. maurus* (F. Cuvier), but in 1840 Lesson himself removed *M. maurus* to his new genus *Rhesus*, leaving in *Magus* only *Simia sylvanus* Linné, which thus became the type. *Gymnopyga* Gray, 1866, is available for *Magus* Elliot (nec Lesson), as noted below.

1828. "*Pithes* Burnett, Quart. Journ. Sci. Litt. and Art. XXVI, p. 307, Oct.–Dec., 1828.
"Type: *Pithes ? sylvanus* (=*Simia sylvanus* Linnæus, from northern Africa." (Not seen; from Palmer, Index Gen. Mamm., 1904, p. 540.)

1841. *Salmacis* Gloger, Hand-u. Hilfsb. Naturg., I, 1841, p. 35.
New name to replace *Macaca* Lacépède, 1799, apud Palmer, Index Gen. Mamm., 1904, p. 617. (Gloger's work not seen.)

The foregoing eight names are synonyms of *Simia* and need not be further considered. The following eleven names have been used for species of the restricted group "*Macacus*," and it is from this series a substitute for *Macaca* must be selected.

1795. *Pithecus* Geoffroy & Cuvier, Mag. Encyclop., III, 1795, p. 462.
Originally contained 5 species, without designation of type.
Type, by subsequent designation (Thomas, 1894), *Simia veter* Linné, an indeterminate species, selected with the express purpose of consigning *Pithecus* "to the limbo of unrecognizable names." In 1913 Elliot,[1] unaware of what Thomas had done in the case, substituted *Pithecus* for *Macacus*, on the basis of priority, and designated *Simia sinica* Linné as the type, an invalid act.

1820. *Silenus* Goldfuss, Handbuch Zool., II, 1820, p. 479.
Subgenus of *Cynocephalus* Illiger.
Type, by monotypy and tautonymy, *Simia silenus* Schreber (nec *Simia silenus* Linné, indeterminable) = *Pithecus albibarbatus* Elliot, ex *Simia* (*Cercopithecus*) *silenus albibarbatus* Kerr = *Ouanderou* Buffon, Hist. Nat., XIV, 1776, pp. 169, 174, pl. xviii.

1839. *Maimon* Wagner, Suppl. Schreber's Säug., I, 1840 (Oct. 1839), pp. iv^{bis}, 141.
As a subgenus of *Inuus*, with 6 species, and without designation of type; 4 of the 6 species are included by Elliot in *Pithecus*. As no type appears to have been indicated I here designate *Inuus erythræus* (F. Cuvier) as the type (= *Simia rhesus* Audebert).

1840. *Rhesus* Lesson, Sp. Mamm., 1840, pp. 49, 95. (Dedication dated Oct., 1840.)
As a subgenus of *Macacus*. Type, by tautonymy, *Macacus rhesus* Desmarest = *Simia rhesus* Audebert.

1840. *Pithex* Hodgson, Journ. Asiat. Soc. Bengal., IX, 1840, p. 1212.
Two species, without designation of type. Type, by present designation, *Pithex oinops* Hodgson = *Simia rhesus* Audebert, apud Elliot.

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[1] Review of the Primates, II, p. 176, June, 1913.

1848. *Lyssodes* Gistel, Naturgesch. Thierreichs f. höhere Schulen, 1848, p. ix.
"Type, *Macacus arctoides* I. Geoffroy" = *Macacus speciosus* F. Cuvier, 1825, apud Palmer, Index Gen. Mamm., 1904, p. 390. (Gistel's work not seen.)

1862. *Vetulus* Reichenbach, Völlständ. Naturg. Affen, 1862, p. 125, pl. xxii, figs. 321–326. Wrongly given to replace *Silenus* Lesson, 1840 (= *Silenus* Goldfuss, 1820).

1862. *Cynamolgus* Reichenbach, Völlständ. Naturg. Affen, 1862, p. 130.
Includes two subgenera (*Zati* and *Cynamolgus*) and 9 species, without designation of types.
Type of *Cynamolgus*, by present designation, *Macacus irus* F. Cuvier (=*Cynamolgus cynocephalus* Reichenbach).

1862. *Zati* Reichenbach, Völlständ. Naturg. Affen, 1862, pp. 130–133, pl. xxiii, figs. 327–331.
Type, by designation of Elliot (Primates, I, p. xxxviii), *Simia sinica* Linné = *Zati sinicus* Reichenbach).

1862. *Nemestrinus* Reichenbach, Völlständ. Naturg. Affen, 1862, pp. 130–140, pl. xxiv, figs. 349–353, 359–363.
Type, by monotypy and tautonymy, *Simia nemestrinus* Linné. Preoccupied for a genus of Diptera.

1866. *Gymnopyga* Gray, Proc. Zool. Soc. London, 1866, p. 202, pl. xix.
Type, by monotypy, *Macacus innominata* Gray (= *Macacus maurus* F. Cuvier, apud Elliot). Hence not a true macaque. The name should replace Elliot's *Magus* (nec *Magus* Lesson).

From the above it is evident that not only is Elliot's use of *Pithecus* untenable but that all but one of the names he adopted for his subgenera of *Pithecus* are also untenable.

The available name to replace *Macaca* Lacépède (*Macacus* auctorum) is *Silenus* Goldfuss, 1820. Owing to the confusion that has always attended the identification of *Simia silenus* Linné, *Silenus* is not an ideal substitute for *Macacus*, the genotype for *Silenus* being *Simia silenus* Schreber (nec Linné) = *Silenus albibarbatus* (Kerr), primarily the *Ouanderou* of Buffon.

Maimon Wagner, 1839, the next name in order, with *Simia rhesus* Audebert as genotype (here designated), is involved with *Mormon*, both *mormon* and *maimon* having been used specifically for the same species (*Simia sphinx* Linné), as well as for different genera of Primates.[1]

Rhesus Lesson (1840), type *Simia rhesus* Audebert, fills every qualification except that of priority, it being one year later than *Maimon* and twenty years later than *Silenus*, and is of course therefore unavailable. For these reasons *Silenus* seems the necessary choice as the name of the group of late commonly known as "*Macacus*."

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[1] Trouessart (Cat. Mamm., Suppl., 1904, p. 21) used *Maimon* as a "nom. nov." for a subgenus of *Papio*, to replace *Mormon* Lesson, nec Illiger.

It happens that Dr. Elliot was not only unfortunate in his selection of a generic name for the macaques, but also in selecting names for the subgeneric divisions of the genus, of which there are five.[1] The first is without name and may be supposed to represent a subgenus *Pithecus.* But this is not really the case, since his type of *Pithecus* is the sole species of his subgenus *Vetulus,* which is a pure synonym of *Silenus.*

For his second subgenus the name *Nemestrinus* is used, which is preoccupied by *Nemestrinus* Latreille, 1802, for a genus of Diptera.

His third subgenus, as stated above, is *Vetulus* Reichenbach, 1862, a name given to replace *Silenus,* and as *Vetulus* has the same type as *Silenus,* the latter becomes the typical subgenus of *Pithecus* Elliot.

His fourth subgenus bears the name *Zati* Reichenbach, 1862, with *Simia sinica* Linné as type by designation of Elliot, and requires no change.

His fifth and much the largest subgenus is designated *Macacus,* now shown to be unavailable. For this *Cynamolgus* Reichenbach may be substituted, with *Macacus irus* F. Cuvier as type, as above designated.

The generic and subgeneric names of the macaques, as now determined, may be shown in comparison with Elliot's, as follows:

	Elliot, 1913.	Allen, 1916.
	Genus *Pithecus* Erxleben, 1777.	Genus *Silenus* Goldfuss, 1820.
	Subgenera.	Subgenera.
1.	———	*Lyssodes* Gistel, 1848.
2.	*Nemestrinus* Reich., 1862.	*Rhesus* Lesson, 1840.
3.	*Vetulus* Reich., 1862.	*Silenus* Goldfuss, 1820.
4.	*Zati* Reich., 1862.	*Zati* Reich., 1862.
5.	"*Macacus*" Lacépède, 1799.	*Cynamolgus* Reich., 1862.

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[1] Subgenus *Neocebus* in Vol. II, p. 224, is a duplication, by error in make-up, of *Neocebus,* a subgenus of *Lasiopyga,* on p. 319 of the same volume. *Cf.* Elliot, Primates, Vol. I, p. xl. and Vol. II, p. 319. See also Vol. I, p. lx, where *Neopithecus* appears in error for *Neocebus!*

59.9,32A:15

Article VI.— HABITS OF *APLODONTIA.*

By H. E. Anthony.

In July and the early part of August, 1915, the author collected material for a group of *Aplodontia,* the "Showt'l" or so-called Mountain Beaver, for the American Museum of Natural History. This material comprised a series of specimens with accessories (plants, shrubs, soil, etc.), and involved a study of as many of the peculiarities of the animal as could be observed. As the habits of *Aplodontia* are but imperfectly known an account of such facts as were recorded may be worth while.

The only accounts of the animal that I have seen exceeding several lines in length are those of Coues [1] and of Stephens.[2] Coues wrote in part from data supplied by early observers, men often not very precise in their distinctions between the showt'l and other mammals of the region, and as he himself at times queried the accuracy of the observation some of the habits accredited to *Aplodontia* may well be questioned.[3] The life of the species here under consideration may differ from that of kindred relatives of the genus, but the following comments are given for what they may be worth.

Specimens were collected in the vicinity of Tillamook, Oregon, where the animals were found in abundance. This species proves upon examination and comparison to be *Aplodontia pacifica* Merriam.

The showt'l in some of its habits, and also in superficial appearance, greatly resembles some large pocket gophers (*Thomomys*). This resemblance was noted as far back as 1876 when Coues (*l. c.*, p. 559) made mention of this fact. The writer had been struck by the similarity before Coues was read, and found it difficult not to think of *Aplodontia* as a relative of the Geomyidæ rather than a sciuromorph. This resemblance, which has so distorted the external affinities of the animal, points suggestively to a firmly fixed fossorial habit and to a certain extent to a parallelism with the habits of the Geomyidæ.

The showt'l if not strictly nocturnal is at least so much so that the animal can rarely be seen during the day. Although a number of runways were visited and I was daily in places where evidences of activity were manifest,

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[1] Elliot Coues, Monographs of North American Rodentia, No. IX, Haplodontidæ. 1876.

[2] Frank Stephens, California Mammals, 1906, pp. 93–95.

[3] Coues (*l. c.*, p. 597).

I saw none of the animals themselves. Those caught in traps were frequently alive when the rounds were made in the morning and one such individual furnished me most of my points on behavior. Because of this difficulty in actually observing the working animals and because of the great labor involved in excavating the underground workings of a "colony," a practical impossibility in most cases about Tillamook, some of the conclusions drawn are conjectures only, but conjectures that appear to be well supported by the data that could be gathered.

The "colonies" of this animal, if the word colony is strictly applicable here, a point I shall discuss later, were found most frequently where vegetation was rankest and where moist loose soil made digging easiest. When such a place is encountered the large holes and piles of earth thrown out from the burrows are generally numerous and indicate the presence of several individuals as well as a marked degree of activity of the individual.

While it has been asserted that *Aplodontia* is a gregarious animal, and lives in colonies of several individuals, it is however more than probable that this number is not very great. A series of runways is inhabited by a single family, and there is no evidence that this animal is as social in its habits as, for example, *Cynomys* or *Microtus*. One might be led to suppose many individuals were present because of the amount of earth thrown out and the numerous runways but this is easily accounted for by the activity of the showt'l. Traps set in the runways were almost always successful the first night, one and possibly two animals being caught. Thereafter traps set in the same immediate vicinity yielded nothing for several days at a stretch, probably until some neighbors wandered over from nearby runways. This lack of success in trapping after the first two or three animals were caught was not due to caution on the part of the animal for *Aplodontia* exhibits no inherent cunning and is easily caught in exposed traps. Furthermore no fresh dirt was thrown out after the first animals were caught, nor were any of the cut leaves and green twigs so commonly lying about the burrows to be seen. All the evidence pointed unmistakably to a depletion of the colony; after two or three had been caught the burrows had a lifeless appearance and debris that had fallen into the runways was undisturbed. By shifting the traps about it was ascertained that the area dominated by these few individuals was rather extensive, for not until traps had been shifted some distance could another set of animals be taken.

The subterranean workings of the showt'l are externally simple. The plan is one or more long main runways opening to the surface by short side burrows at frequent intervals. The diameter of these runways is from six to ten inches, depending on the nature of the soil, and the floor of the tube is kept quite clear of loose dirt. Generally the runway follows any natural advantage, such as fallen logs, and here often the burrow is so shallow that it is but half its normal diameter into the soil, the log serving to cover it over. In such spots the floor of the runway is seen to be well trodden down and where the runway crosses a short distance from one log to another it becomes a mere path, but a path with vegetation and small obstacles removed. Where exit to the surface is made from a deeper runway the course of the short burrow is direct and often the main runway can be readily seen by looking through its short length. Loose dirt is brought to these burrows and pushed out, being carried just far enough to be out of the way. The main runways, in many cases, may extend for more than 100 feet, but the exact extent is necessarily hard to determine. The average depth below the surface is eight inches to a foot. Nothing could be learned of the nest or home chamber of the animal.

The dirt is handled much in the same fashion as the pocket gopher works. A mass of loose earth is pushed ahead of the body by the chest and shoulders, the broad blunt head also being used to shove aside the dirt. Where large quantities of earth were being excavated nightly these facts could be observed in the morning from the imprints in the loose piles of soft earth. Here could be seen a fan-shaped dump, in miniature like those at the entrance of underground mines, where the dirt was pushed to the edge and allowed to roll down a foot or so to the ground level. It should be here stated that the burrows always open out to utilize the down grade of any little slope at hand. Over the top of the dump could be seen a depression where the showt'l pushed along before him his load of dirt, and often the modeling of the soft earth showed the imprint of his blunt nose where he pushed aside the walls to make more room for his dirt to pass.

Showt'ls when caught in the trap without serious injury are very pugnacious and at such times when two are brought together fight ferociously. They will bite fiercely at sticks or any objects thrust near them and I imagine that under ordinary circumstances this pugnacity would serve to keep the inhabitants of a series of burrows few in number. Their resemblance in behavior to the pocket gopher, under similar conditions, indicates that the showt'l may have the same surly home life.

An animal caught in a steel trap by the leg but with no bones broken was found the morning of July 28, and was kept alive to observe his habits. He was very aggressive while in the trap and when brought near another captive, also uninjured, after the first tussle he created such a respectful attitude in showt'l No. 2 that the latter strained at the chain to keep out of his reach. They were separated before either had been hurt, for the powerful incisors and strong jaw muscles are capable of giving deep wounds.

While in the trap great care in handling the animal had to be exercised. He was placed in a box and kept from escaping by a board laid across the top.

Before he had been in captivity twenty-four hours he was taken out to be photographed. A wire fastened to a hind leg prevented escape and he was put down in a spot resembling his habitat. After several determined efforts at escape, he suddenly stopped his struggles and grabbing a tender young shoot of the "elk-brake" by which he was surrounded proceeded to feed as quietly and as unconcernedly as if he were perfectly free. He was quite touchy however, and any sudden movement brought forth an attempt at freedom. He sat up a great part of the time, and if annoyed while in this attitude sparred like a bear with his fore paws, showing a perfect control of his position.

So rapidly did he become tame that by nightfall of the first day he took young fern shoots from my hand and ate them while seated upon the window sill of my room, completely oblivious of my presence. His appetite was good and he ate a number of fern tips, generally selecting the youngest and softest from the handful offered him. The elk-brake, *Pteris aquilina,* that seems to be one of his main articles of diet, has many branching stems that bear the green foliage. The showt'l clipped off an inch or two of the terminal stems, a single snip of the sharp incisors generally severing the small stem. Then holding this stem in his fore paws the animal passed the tender fronds back between the molars, and with a rather hurried crunching munched them down, mastication though rapid seeming to be quite thorough and audible as well. The lateral stems were clipped off close to the main stem and after the greenest of the terminal stems had been eaten the animal, after sniffing over the rest of that particular fern, passed on to a fresh one, some preference being given to the more succulent portions. If a stem that was fairly hard and brown was trimmed off, after the fronds had been devoured it was discarded. The posture of the animal was squirrel-like, with the back somewhat arched.

He drank large amounts of water when it was given him. He put his nose into the water and drank, and did not lap up water. This showt'l was liberated on the bank of a small clear brook and as an experiment he was put out into a fairly deep pool. He swam ashore showing no fear whatever of the water, but evidently displaying no particular fondness for it. He swam well and rapidly, and his unfrenzied procedure showed he had no dread of the water. He looked very much like a slowly swimming tailless musk rat.

Despite the fact that the showt'l has been described in literature as being a water loving animal, I do not think they ever swim from choice. He spent some time after coming ashore in shaking out his fur and going over his sides and belly before he felt sufficiently comfortable to begin eating.

This captive animal washed his face after the manner of small mammals, reaching back with the fore paws onto his shoulders and hinder neck readily, the movements being short, quick dabs. When irritated he twitched the whiskers energetically and when most angry uttered a husky querulous note somewhat like a cough. He often satisfied his curiosity by sniffing and working his nose, and this member seemed to be very sensitive, for the slightest blowing upon it produced spasmodic starts. When aroused his eyes had a bright alert appearance, but quickly took on a dull listlessness when the animal relaxed at ease.

His body was very hard and firm to the touch. When running loose on the floor and I put my hand upon him, he seemed to brace himself and became rigid at times. He could give sharp scratches when held but did not seem to be able to squirm very effectually because of his short thick neck and the heavy musculature of the fore parts.

By the end of a week he had become so tame that he never offered to bite. He seemed to accept the conditions as inevitable and, not showing any appreciation of caress that some tame animals display, his attitude was one of complete indifference. He soon cut off the toes from the foot that had been pinched in the trap, but evinced no concern over the fact. No attempt was made to gnaw out of the box that kept him prisoner.

A pronounced musky odor is given off by the animal and is noticeable in skins some months old. It is very noticeable in a freshly killed animal, it having a strong penetrating quality, rather pleasant than otherwise. It recalls, most nearly, the scent of the musk-rat, *Ondatra.*

No very young showt'ls were noted or taken. The youngest are about three quarters grown and have the permanent pm^4 just appearing beneath the milk predecessor. This fact would indicate either that there is a definite period of birth in the spring, and not an indefinite term extending over most of the early summer when young might be taken up to the fall months, or else that the young do not leave the underground nest until nearly adult. This latter hypothesis has little to support it.

A variety of plants were noted as forming the food of *Aplodontia.* All of the more common plants and shrubs seemed to contribute, those noted especially being the thimble-berry (*Rubus* sp.?), the large elk-brake (*Pteris aquilina*) and the sword-fern (two species of *Aspidium*) but in general any of the green leaved plants might be eaten. The elk-brake and sword-fern seemed to be the food most preferred and often cut stems and fronds were to be seen in the burrows and runways. Leaves alone are eaten and there was no evidence that bark or roots were consumed.[1] I was told by the farmers that the showt'l not infrequently cut piles of green vegetation and left it outside to 'cure' into hay, taking it into the burrow presumably to store up, a proceeding analogous to a habit of the cony (*Ochotona*). I am unable to vouch for the truth of this as no such 'hay piles' were noted, but other writers (*cf.* Coues and Stephens) mention this habit, so my informants were undoubtedly correct in their statements. As there was an abundance of green food to be had in July, it is not unlikely that foliage is stored up only at the end of the summer when the green leaves are about to disappear.

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[1] Coues (*l. c.*, p. 587) comments on the capacious alimentary system, which is of a type to deal with bulky food such as the foliage of plants.

Much has been made of the semi-aquatic tendencies of this animal, which has been credited with seeking sites where water courses sometimes were in part deflected into their borrows. This is doubtless often the case, for the showt'l seeks abundant green vegetation and this is oftenest found where there is water. However, *Aplodontia* shows no marked predilection for water, since in the humid coast belt, where Tillamook is situated, the rainfall alone is sufficient to induce luxuriant vegetation and here the comparatively dry hillsides harbored many families of the showt'l. From the behavior of my captive animal, I believe that water is tolerated when it is a necessary adjunct, but is avoided when sufficient food can be found otherwise. This may be so, however, only in the case of this species, and other forms may be more truly sub-aquatic.

Much the largest and most flourishing colony was found in the orchard of a deserted farm. Here under 'evergreen' blackberry bushes large quantities of earth were thrown out every night and great activity was evident. It is not improbable that the tall rank grass and such low fleshy leaved plants as the dandelion were the important food items here, for cut grass stems were seen about the burrows, and the absence of any other suitable food went to support this supposition.

It was suggested by the farmers that some of the inroads upon potato fields were made by showt'ls, on account of the presence of burrows on the adjacent uncultivated land. Traps set in the potato fields, if at any distance from the waste lands, did not catch *Aplodontia*, and I collected no very positive evidence to condemn the animal. The large ground squirrel (*Citellus grammurus douglasii*) was quite common in this region and the credit for the damage to farm produce must be given in the greater part to this animal and to the chipmunk (*Eutamias townsendi*). No unquestionable *Aplodontia* burrows were noted running out into the cultivated fields.

The showt'l probably is not very extensively preyed upon by hawks or owls, owing to the dense cover of vegetation beneath which he works and also to his nocturnal habits. However, predaceous animals use his burrows and runways, for two weasels (*Putorius saturatus*) were caught on successive nights in one runway, and I was told that skunks (*Spilogale*) were not uncommonly caught by the farmers in traps set for *Aplondontia*.

Explanation of Figures.

Figure 1. *Aplodontia* sitting on haunches in characteristic attitude. The fern that is shown in this figure is the elk-brake (*Pteris aquilina*) that appears to be one of the most important articles of diet of this species.

Figure 2. *Aplodontia* in feeding attitude, eating the terminal fronds of the elk brake. Note the squirrel-like pose.

Figure 3. Shows the broad blunt head of the showt'l which bears a strong likeness to that of a pocket gopher (*Thomomys*). The whiskers are prominent and are doubtless important as tactile organs.

Figure 4. Showt'l photographed by means of a flashlight apparatus set where dirt was nightly excavated. Note the great mass of loose dirt and the trail over the top where the animal passed to and fro in pushing out earth from the burrow. This burrow was at the base of a thick clump of "evergreen" blackberry bushes.

Figure 5. Side exits from a main burrow showing how logs are utilized in running a burrow. The main tunnel here runs under the log and parallel with it.

Figure 6. A large burrow in loose soil formed largely of humus from the decaying elk brake. In such spots the tunnels are large and capacious because excavation is so easy. The roof often falls in when the tunnel passes close to the surface.

Figure 7. A well worn side burrow on a fairly open hillside. Note the clean appearance of the floor of this borrow. Burrows that are in nightly use have all loose debris cleared out and thus show unmistakable evidence of occupancy.

Figure 8. An exit in a locality where the ground was rather thickly carpeted with moss and fallen leaves. Under these conditions the showt'l is less apt to disclose his presence as the soft moss shows runways but poorly.

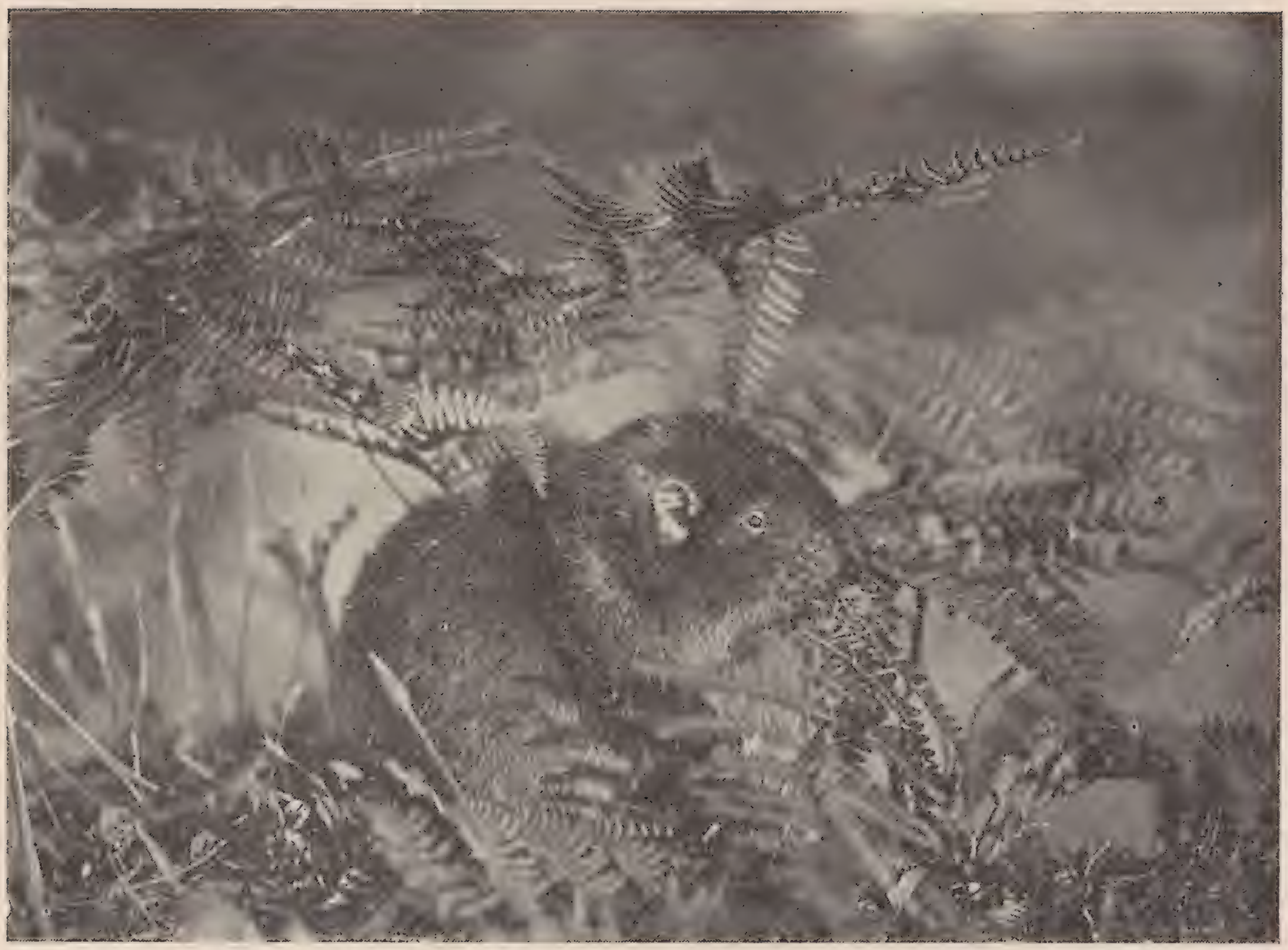

Fig. 1.

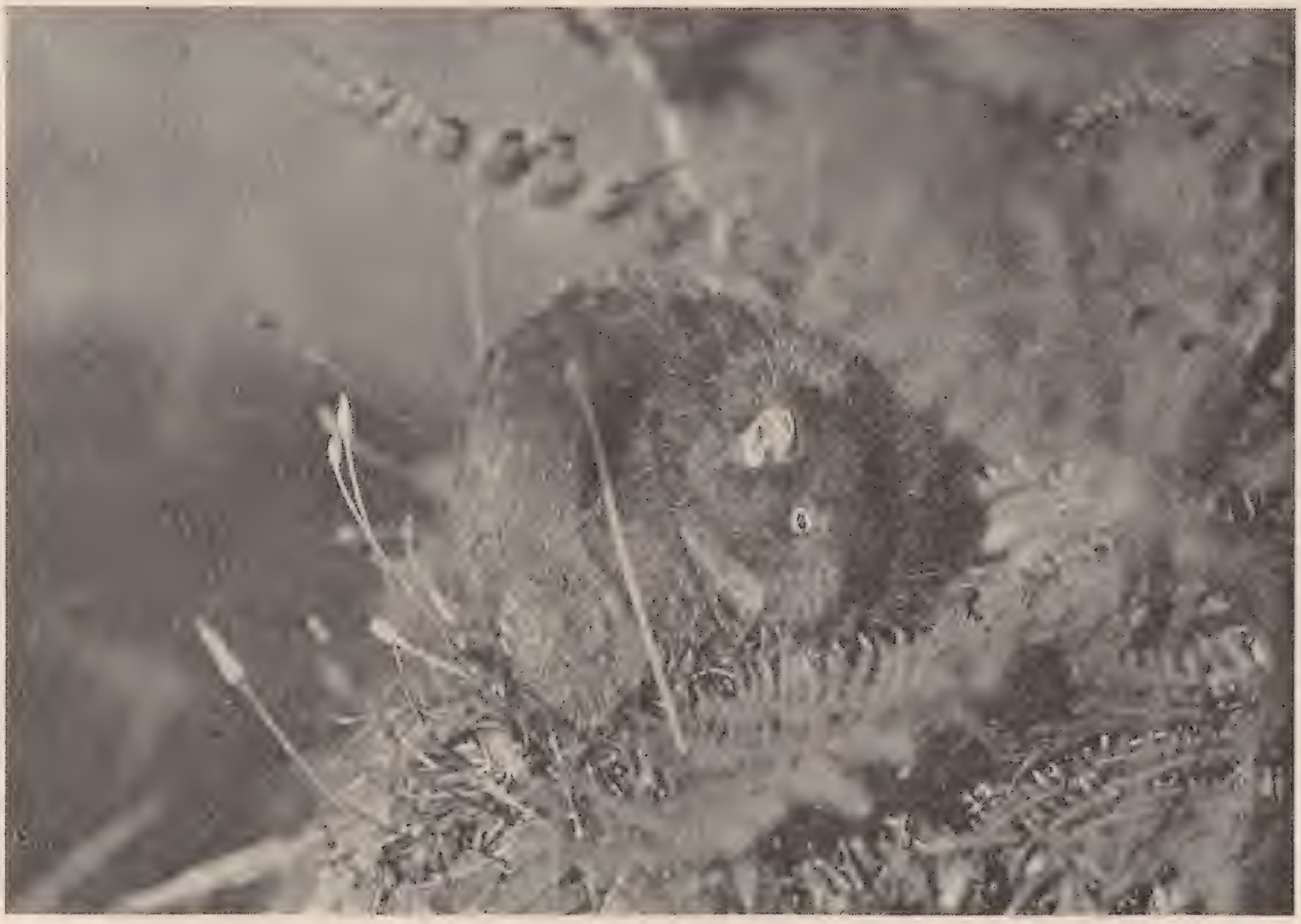

Fig. 2.

Habits of *Aplodontia*.

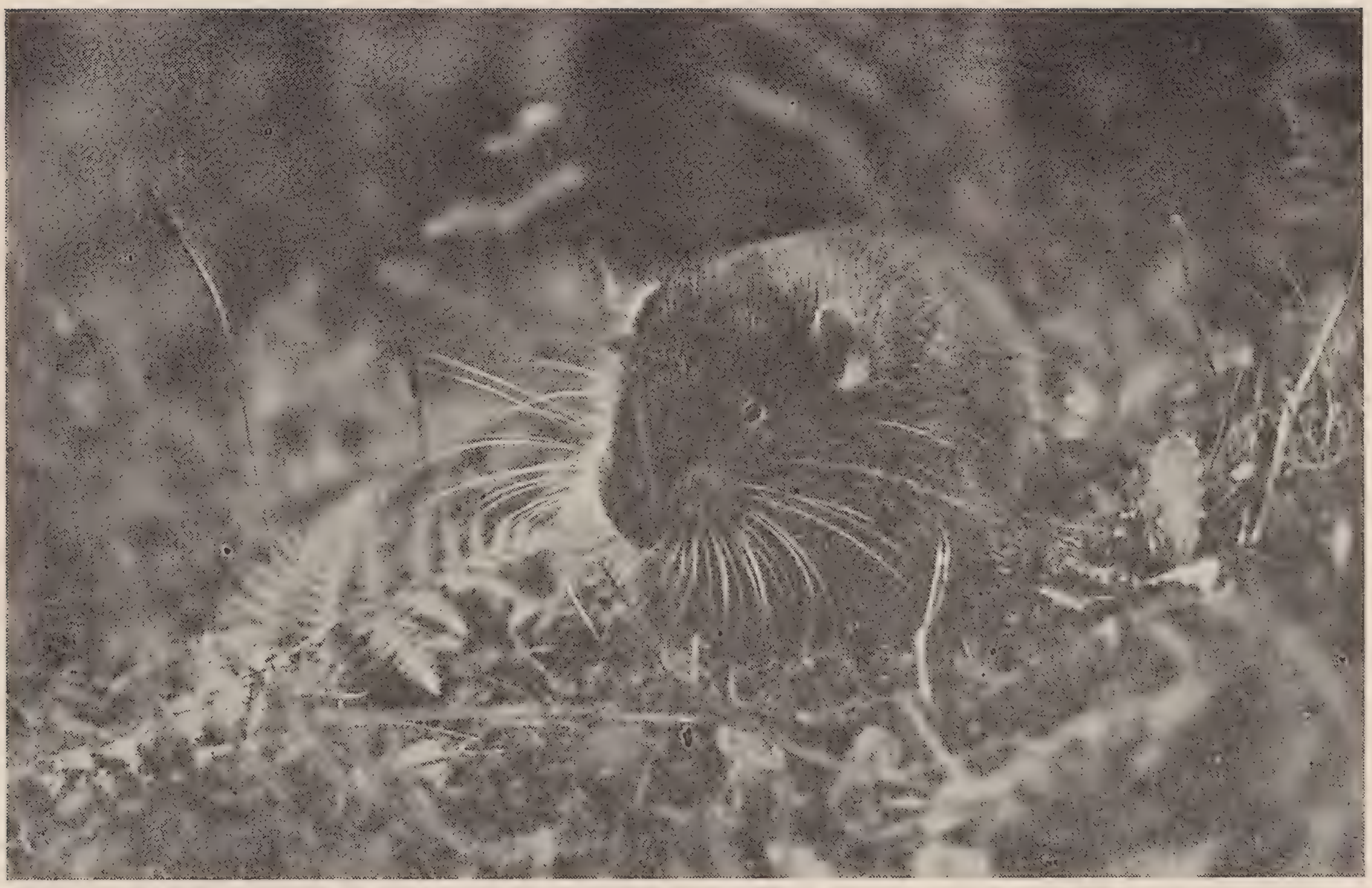

Fig. 3.

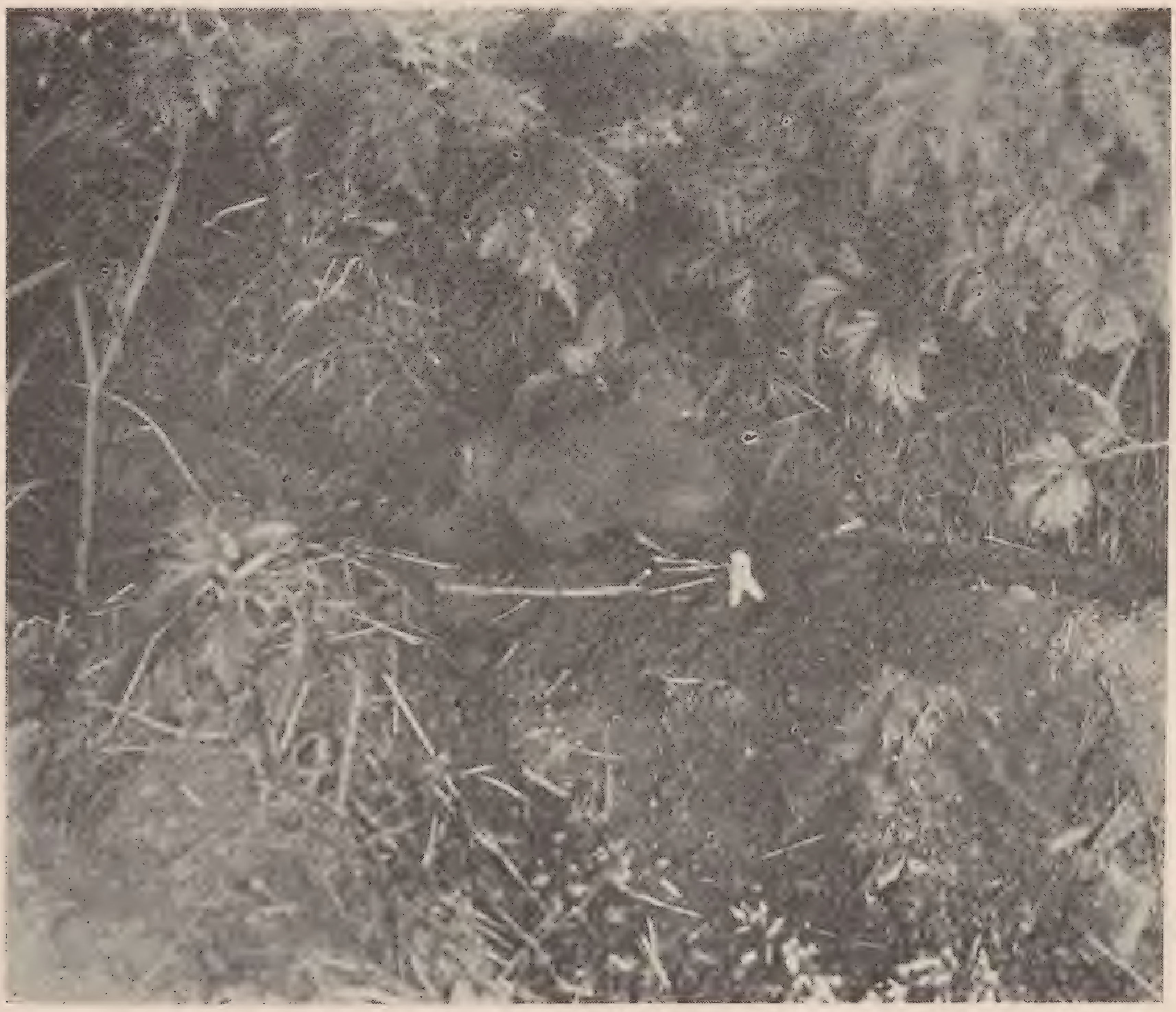

Fig. 4.

Habits of *Aplodontia*.

Fig. 5.

Fig. 6.

Habits of *Aplodontia.*

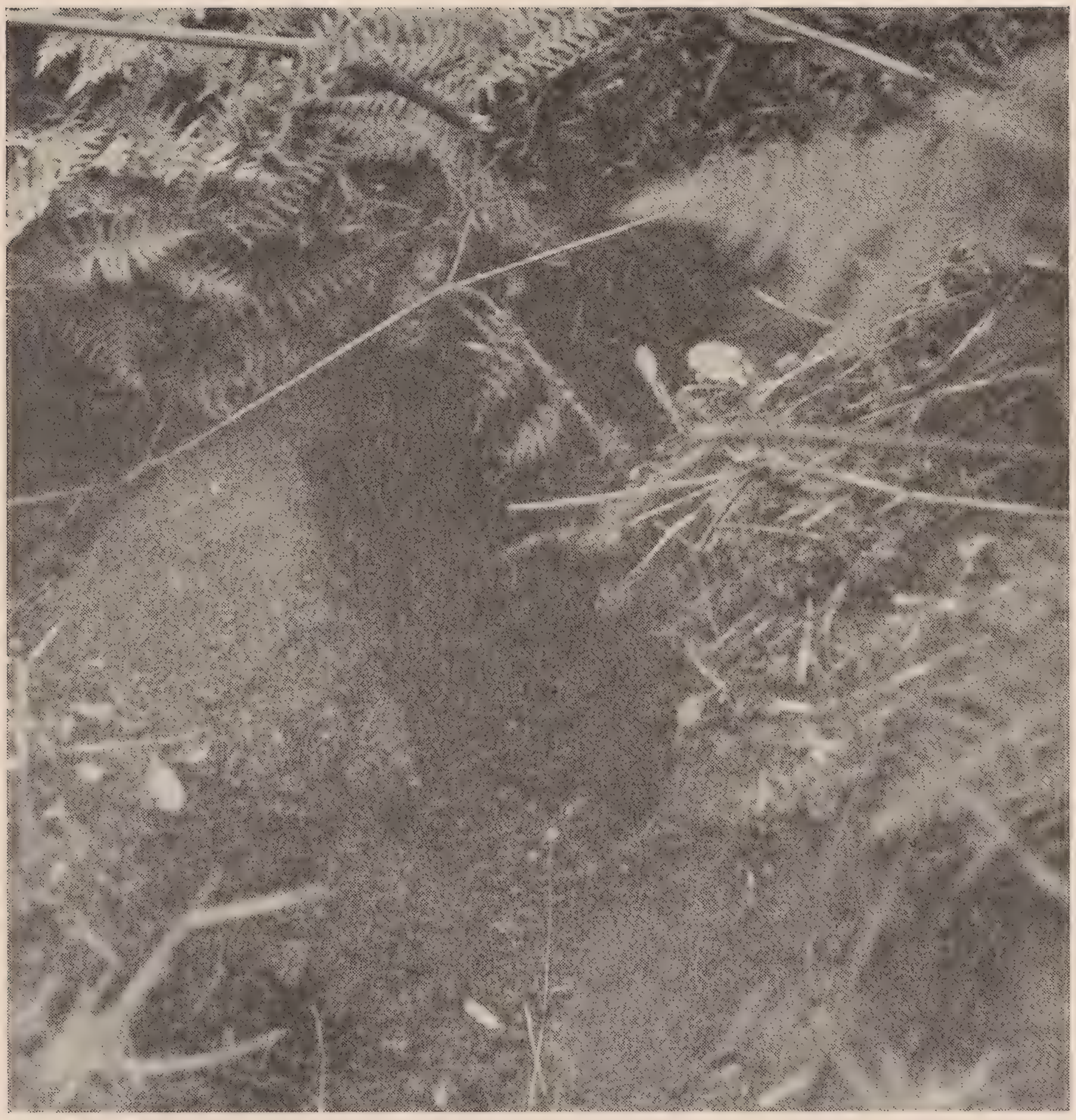

Fig. 7.

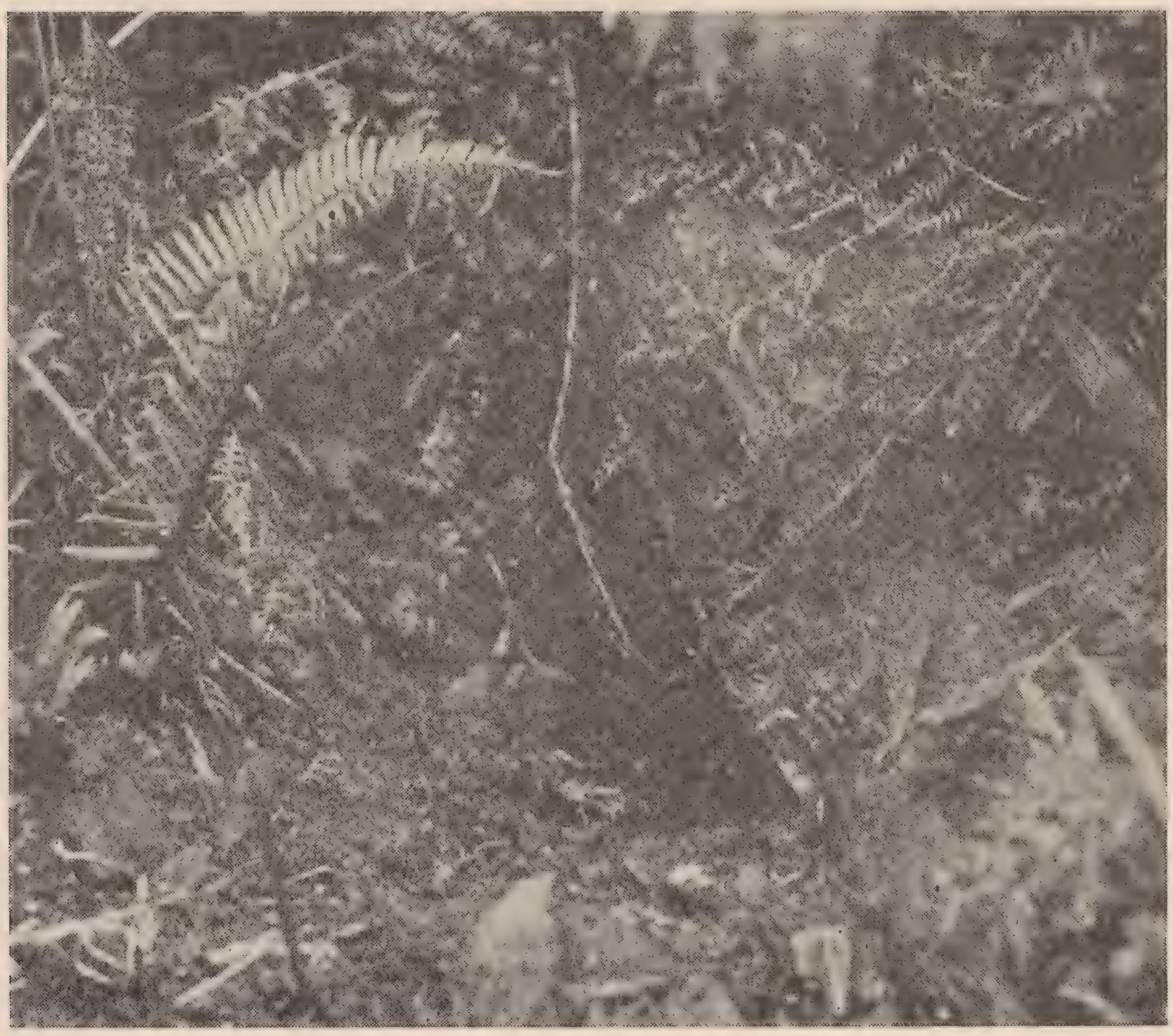

Fig. 8.

Habits of *Aplodontia*.

59.84,2P

Article VII.— TWO NEW DIVING PETRELS.

By Robert Cushman Murphy and Francis Harper.

Recent studies on the Pelecanoididæ have brought to light a new species and a new subspecies, descriptions of which are here presented in advance of the publication of a detailed review of the entire family.

Pelecanoides urinatrix chathamensis subsp. nov.

Type locality.— Chatham Islands, about latitude 44° S., longitude 177° W.

Type specimen.— No. 151112, U. S. National Museum; adult male; collected in February, 1893; received from S. Dannefaerd.

Geographic range.— Chatham Islands and adjacent waters.

General characters.— Similar in coloration to *Pelecanoides urinatrix urinatrix*, but smaller.

Adult male.— Length (skins), 182–196 (187); wing, 111.5–114 (112.8); tail, 34–37 (35.7); exposed culmen, 15–15.5 (15.3); width of bill, 7.5; depth of bill,[1] 6–6.5 (6.2); tarsus, 25–26 (25.7); middle toe and claw, 31.5–33 (32.2).[2]

Adult female.— Length (skin), 175; wing, 109.5; tail, 34.5; exposed culmen, 15.5; width of bill, 7; depth of bill, 6; tarsus, 24; middle toe and claw, 29.[3]

Remarks.— The specimens of *P. u. urinatrix* used for comparison are virtually topotypes of that form, since they were secured at Stephens Island, New Zealand, approximately 30 miles from Queen Charlotte Sound, the type locality. The measurements of the two forms are compared in the following table:

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[1] Measured just in front of nasal tubes.

[2] Three specimens.

[3] One specimen.

Pelecanoides urinatrix urinatrix.

Locality	Wing	Tail	Exposed culmen	Width of bill	Depth of bill	Tarsus	Middle toe and claw
One adult male from Stephens Island......	133	41	16.5	8	7	27	35
One adult female from Stephens Island......	123	38	17	8	7.5	28	33

Pelecanoides urinatrix chathamensis.

Three adult males from Chatham Islands.....	112.8	35.7	15.3	7.5	6.2	25.7	32.2
One adult female from Chatham Islands.....	109.5	34.5	15.5	7	6	24	29

Specimens examined.— Four, from Chatham Islands.

Pelecanoides georgica sp. nov.

Type locality.— Cumberland Bay, South Georgia, latitude 54° 16′ S., longitude 36° 26′ W.

Type specimen.— No. 132451, American Museum of Natural History; adult male; collected December 26, 1914, by José G. Correia.

Geographic range.— South Georgia and adjacent waters.

General characters.— Size small, approximating that of *P. urinatrix chathamensis;* bill less deep, proportionately wider at the base, and laterally more tapering, than in other Pelecanoididæ; processes on internasal septum more prominently developed and more anterior in position than in any form of *P. urinatrix;* mottling of jugulum decidedly variable, becoming very pronounced in some specimens.

Adults (sexes alike).— Upper parts glossy black; scapulars grayish white, with an obscure subterminal band of deep neutral gray, broader and slightly darker on outer web; the scapulars more or less overlaid and concealed by the dark interscapulars, but forming in many specimens a broad, conspicuous diagonal stripe; wings glossy black, more or less tinged with brownish, especially on primaries; secondaries generally edged narrowly with whitish, and primaries becoming pale on edge of inner web; under wing-coverts white, sometimes mottled with pale neutral gray, and the shafts sometimes dark terminally; rectrices blackish brown, with a slight gloss, paler on the under surface, and the worn lateral feathers sometimes showing whitish edges; anterior part of forehead and lores suffused with clove brown; under parts white; cheeks and sides of neck deep neutral gray, the feathers narrowly tipped with white; this gray mottling varying much in intensity and distribution, and in some specimens extending completely across the jugulum; axillaries, sides, and flanks barred more or less strongly with neutral gray, the feathers tipped with white; feathers of tibia deep mouse gray; down plumules and after-shafts over entire body varying from deep mouse gray to dark mouse gray, with lighter tips. Processes on internasal septum situated at its longitudinal center. Bill black, rami of mandible slaty; iris seal brown; tarsi and toes flax-flower blue; webs black.

Adult male.— Length (skins), 193–218 (202.6); wing, 104–122 (112.7); tail, 34–42 (37.7); exposed culmen, 14–16 (14.9); width of bill, 8–10 (8.9); depth of bill, 5.5–6 (5.8); tarsus, 22–26 (24.4); middle toe and claw, 27–33 (30.1).[1]

Adult female.— Length (skins), 181–215 (198.2); wing, 104–120 (113.8); tail, 34–43 (38.2); exposed culmen, 14–16 (14.7); width of bill, 8–9.5 (8.8); depth of bill, 5–6 (5.7); tarsus, 21–26 (24.2); middle toe and claw, 26–32 (29.9).[2]

Specimens examined.— Total number, 246, all from South Georgia.

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[1] One hundred specimens; only twenty, however, measured for total length and for depth of bill.

[2] Eighty-five specimens; only twenty, however, measured for total length and for depth of bill.

59.7,55R(71.2)

Article VIII.— ON A NEW RACE OF MINNOW FROM THE ROCKY MOUNTAINS PARK.

BY JOHN TREADWELL NICHOLS.

Rhinichthys cataractæ smithi subsp. nov.

Rhinichthys dulcis EIGENMANN, Bull. U. S. F. C., XIV (for 1894),[1] p. 111.

Type locality. Hot Spring at Cave and Basin, Banff, Alberta.

Type specimen. No. 5514, American Museum of Natural History, specimen in alcohol, collected July 21, 1915, by Harlan I. Smith.

Geographic range. Probably in suitable localities throughout South Saskatchewan drainage, Alberta.

General Characters. Resembles *R. cataractæ dulcis* but differs notably in the fewer scales in lateral line (50 to 60).

Description of type. Total length 44 mm.; length to base of caudal 38 mm. Head (in latter measure) $3\frac{4}{5}$; depth $4\frac{3}{4}$. Eye (in head) $5\frac{1}{2}$; snout $2\frac{4}{5}$; maxillary 3; interorbital $2\frac{4}{5}$. Dorsal 8; anal 7. Scales in lateral line 53. Body fusiform, not much compressed, eye small, snout long, projecting beyond the inferior horizontal mouth, premaxillaries not protractile, maxillaries barely reaching front of eye, with a well developed terminal barbel. Pharyngeal teeth (of right side) 42, hooked. Lateral line complete. Insertion of dorsal distinctly behind that of ventrals, about equidistant between base of caudal and front of eye, slightly nearer the latter. Caudal moderately forked 1.3 in head; longest dorsal ray 1.5; longest anal ray 1.6; pectorals extending $\frac{2}{3}$ distance to ventrals; ventrals $\frac{3}{4}$ distance to caudal. Color in spirits clouded by dark punctulations except on the ventral surface which is white, a blackish band from snout to caudal, almost as wide as eye on middle of side, scarcely half as wide on snout, fins pale, the caudal slightly clouded.

Specimens examined. The type and 4 paratypes, 47 to 30 mm. in total length, and about 25 young, also paratypes, down to 15 mm. in total length. One of this size has head $3\frac{1}{2}$, depth 4. Color pale, the lateral band narrow and faint, ending in a sharp black spot. The largest specimen (47 mm.) has the head $3\frac{2}{3}$, depth $4\frac{1}{3}$, eye about $\frac{1}{2}$ snout. Scales about 60. The two next largest paratypes have scales about 50.

Remarks.— The presumption is that this is the fish recorded by Eigenmann as *dulcis* from Medicine Hat, Calgary, and Banff. Named for the collector, Mr. Harlan I. Smith, of the Victoria Memorial Museum, Ottawa, in recognition of his broad interest in the natural science of the region where it is found. The occurrence of a species characteristic of swift, cool waters in hot springs is interesting, in fact record of fishes in such places is sufficiently rare for their occurrence there to be worthy of remark.[2]

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[1] Eigenmann, C. H. Results of Explorations in Western Canada and the Northwestern United States.

[2] See Nichols, Bull. Am. Mus. Nat. Hist., XXXI, 1912, p. 179, Cuba.

59.7,56g(75.6)

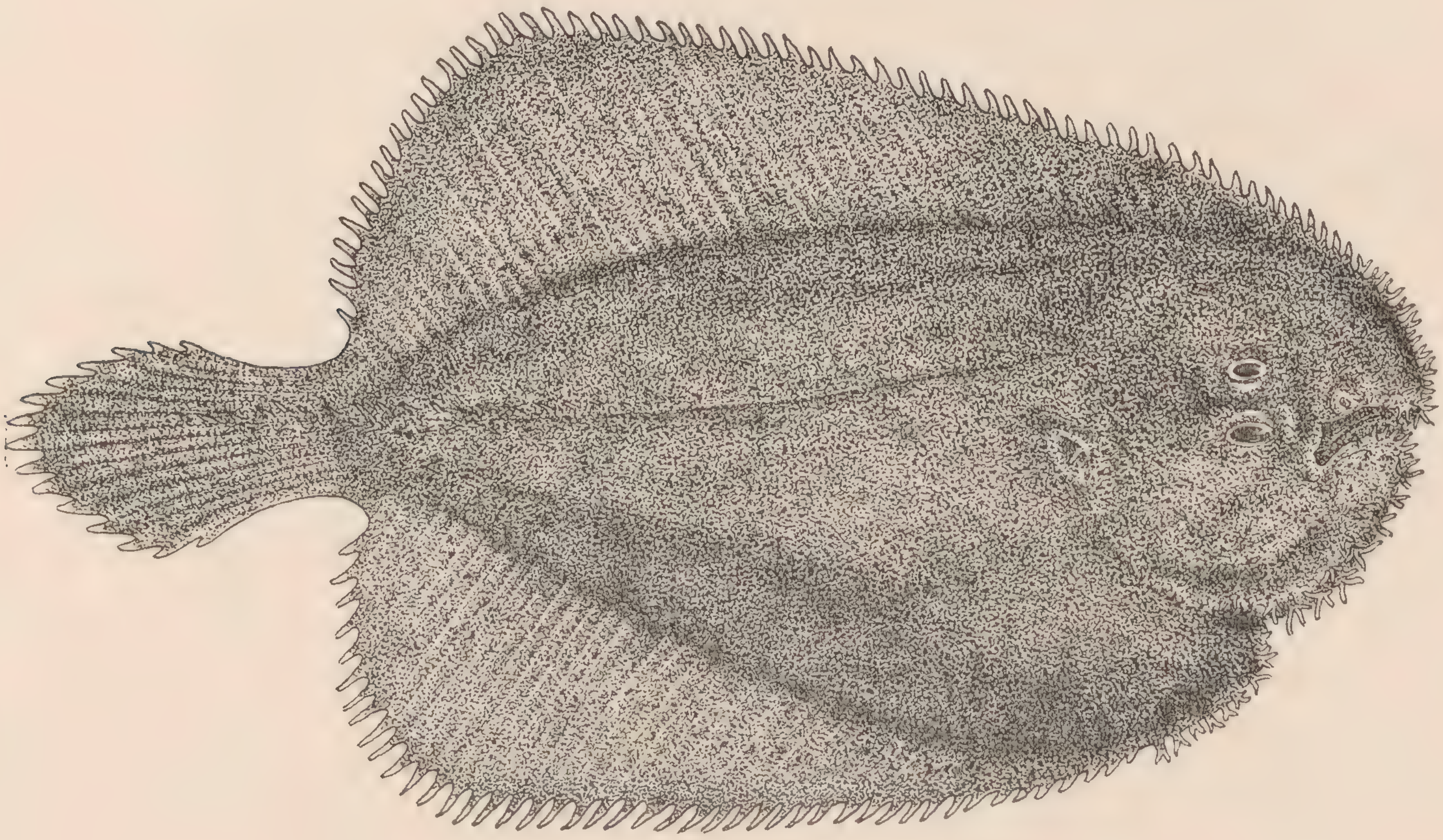
Article IX.— A NEW *GYMNACHIRUS* FROM NORTH CAROLINA.

By John Treadwell Nichols.

In a collection of fishes made at Cape Lookout, N. C., by Mr. Russell J. Coles of Danville, Va., in July, 1915, and presented to the American Museum is a small undescribed naked sole.

Gymnachirus melas sp. nov.

The type, No. 5717, American Museum of Natural History, our only specimen, taken at Cape Lookout, North Carolina, by Mr. Russell J. Coles, is 22 mm. long to the base of the caudal; depth 2.0 in this measure; head 3.2; lower eye 6.5 in head; lower eye to tip of jaw 3.0; greatest depth of caudal peduncle 2.5. Body rather wedge-shaped, broadest anteriorly. The vertical fin rays are longest posteriorly so that the outline of fish, including fins, is somewhat inversely wedge-shaped, broadest behind. Caudal graduated, 1.2 in head; longest dorsal ray 1.3; longest anal ray 1.3.



Gymnachirus melas sp. nov.

Pectoral reduced to a single rudimentary ray. Dorsal about 65; anal about 45. Body scaleless, with small scattered cirri, more numerous on head. Lower side of head, its margin and anterior fins thickly set with larger cirri. Color in spirits, uniform inky black, tips of caudal rays whitish.

Compared with *G. fasciatus* and *G. nudus* figured by Kendall,[1] the present fish has fin and body outlines different from either, and is darker in color. The pectoral is much less developed than in *fasciatus,* although not entirely absent as described in *nudus,* in *melas* it was at first overlooked, not being evident to the naked eye.

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[1] Proc. U. S. Nat. Museum, Vol. 40, pp. 202 and 203, 1911.

59.88,9C(67.5)

Article X.— THE PENNANT-WINGED NIGHTJAR OF AFRICA AND ITS MIGRATION.[1]

BY JAMES P. CHAPIN.

With Map.

In general discussions on the migration of birds, those of the tropics are apt to receive little or no notice; yet ornithologists who have traveled in tropical Africa have sometimes remarked that certain strictly Ethiopian species are present in certain regions only at definite seasons; and similarly in South America — I am told by Mr. Geo. K. Cherrie — migratory movements, perhaps of slight importance, are to be noticed. In very few cases, in Africa at least, have the courses of these migrations been traced; for seldom is the observer able to remain long enough, or to travel widely enough, to complete such investigations.

Thus, during our stay in the northeastern section of the Congo Basin, we also ascertained that while the majority of the birds were resident, certain kinds would depart and reappear in successive years with almost the same regularity that characterizes migrants in more northerly climes. Yet only a part of these were species that came from Europe or Asia in anticipation of winter, others being forms known to occur only in tropical Africa, for whose movements it would be doubly difficult to assign reasons, inasmuch as the temperature varied but slightly from month to month, and rainfall was the main element in the change of seasons. Food might vary, but any danger from lack of it seemed out of the question.

Every year we observed a number of Palearctic birds, about fifty in all. Some of these remained with us throughout the period of northern winter, for example, the kestrel, harriers, common sandpiper, yellow wagtails, swallow, and sand martin. Others such as the white stork, marsh terns, and European bee-eater continued further south, so that we saw them only during migration. But of the truly African birds nearly forty seemed to perform more or less regular migrations, some of which were observed during three successive years. One of the most enlightening cases was that of the Pennant-winged Nightjar (*Cosmetornis vexillarius*), so that from our long experience with it, and from records already published from regions we could not visit (for such a peculiarly conspicuous bird must awaken the interest of any traveller) it has been possible to map its seasonal distribution with considerable accuracy.

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[1] Scientific Results of the Congo Expedition. Ornithology, No. 3. (For No. 1 see this Bulletin, Vol. XXXIV, 1915, pp. 509–513; for No. 2 see Vol. XXXV, 1916, pp. 23–29.)

Before proceeding further, let us first consider briefly the changes of season in equatorial Africa, and the general character of the vegetation. Stretching from Sierra Leone eastward along the northern shore of the Gulf of Guinea (though interrupted in Togo and Dahomey), then southward to Loango, and eastward across the Kamerun, Gabun, and central Congo basin to within a short distance of Lake Albert and the Ruwenzori Mountains, there is a great forest-belt. This is represented even in Uganda and British East Africa, though conditions there are altered through the greater elevation, by rather large forested areas, such as the Mpanga, Budonga, Mau, and Kenia forests.

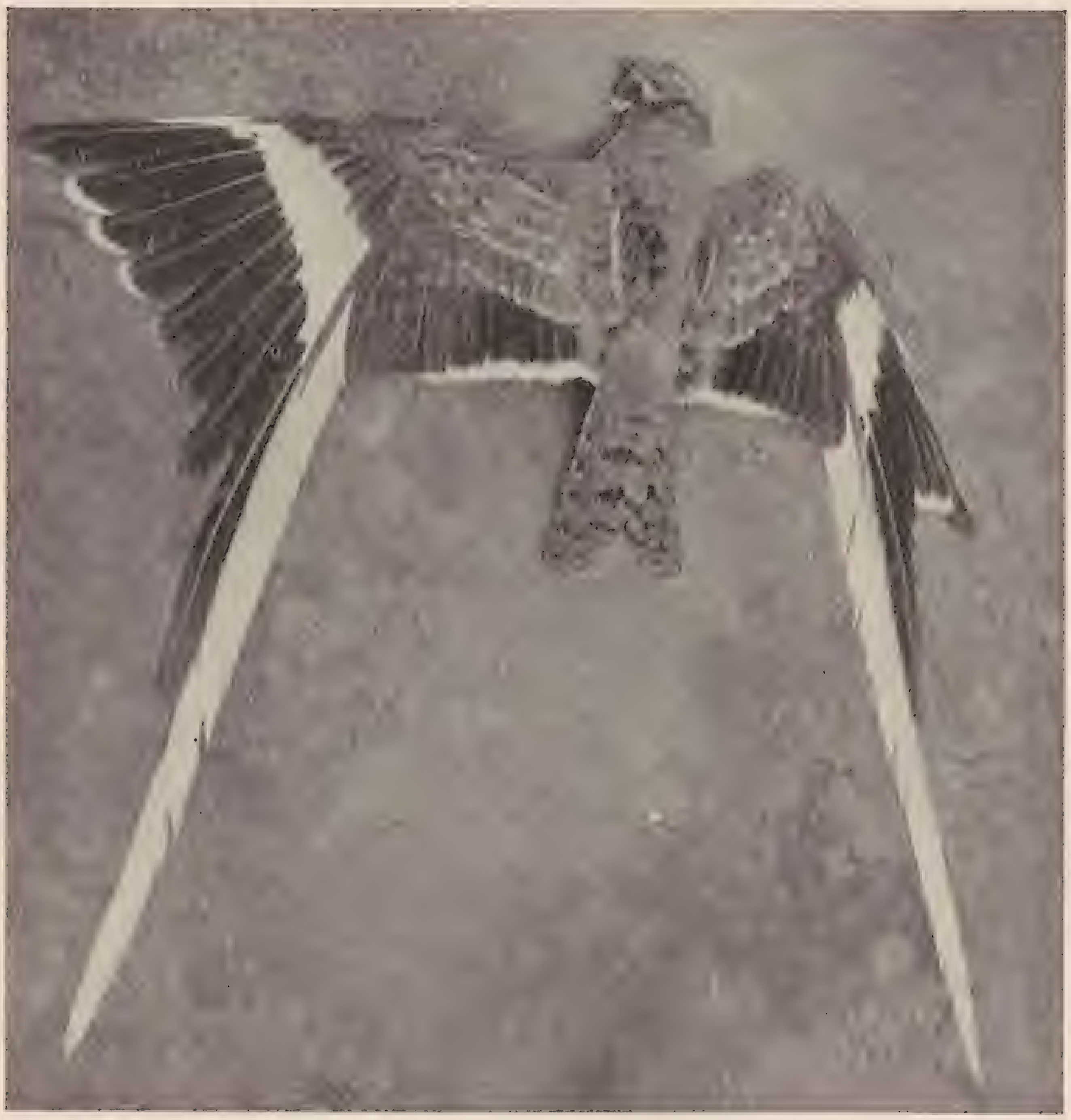


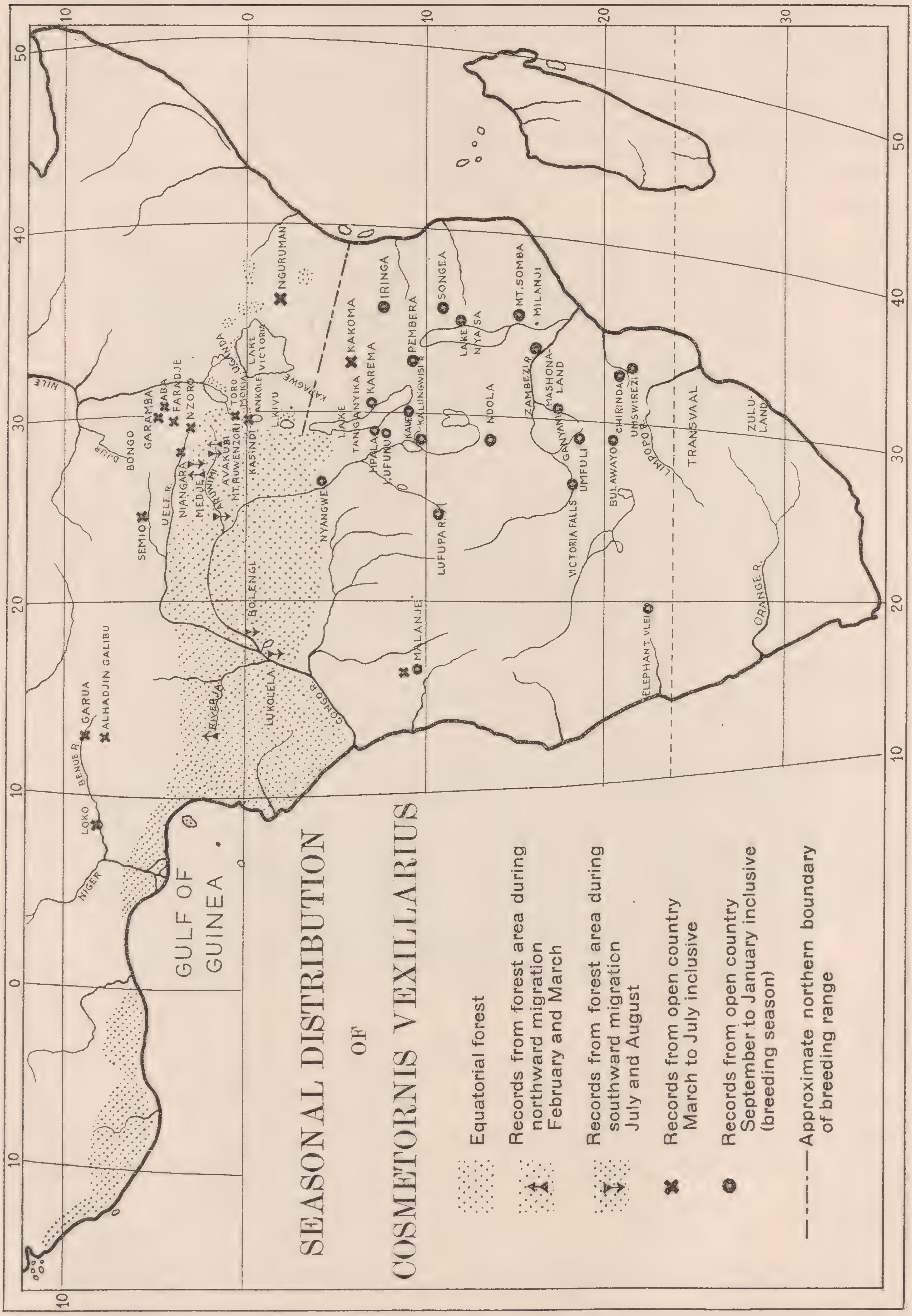
Fig. 1.— Pennant-winged Nightjar (*Cosmetornis vexillarius*).

The northern boundary of the West African forest lies, roughly speaking, between 4 and 9 degrees of north latitude; and its southern edge between 3 and 5 degrees of south latitude. Consequently it offers a formidable barrier to birds of the more open country, a definite equatorial belt, depending upon the more copious rains near the equator, which are apt to be distributed more or less throughout the year, whereas a little further away to the north and south there is one long dry season, and even at as low a latitude as 5 degrees this may last five or six months. These countries of prolonged drought, on the other hand, as well as much of the tableland of eastern Africa, are covered with grasslands, often varied with bushes, or scrub, or wooded along the streams. The grass, as a rule, dries out and is burned off by the natives during each dry season, a time of year which corresponds in a way to the winter of the temperate zones, and covers, to the north of the equatorial forest, the months from December to April at least, while to the southward it is reversed, in agreement with the southern winter.

Now, returning to the birds, we find that Caprimulgidæ are represented on the Ethiopian continent by four different genera, but the two monotypic genera *Macrodipteryx* and *Cosmetornis* are by far the most striking, especially because of the extraordinary modification of the inner primaries in the wings of adult males. With *Cosmetornis vexillarius* the second and third, particularly the former, are long and narrow, truly pennant-shaped, and attain a length of 67 centimeters, 2½ times the total length of the bird, from the bill to the tip of the tail. Several of the other primaries are somewhat lengthened so that the whole outline of the wing is altered and squared, the longer feathers waving out behind in flight. Once seen on the wing it can never be forgotten; it immediately impressed me as a weird, strangely exaggerated, batlike creature.

Our first year in Africa was spent within the limits of the forest region, and this curious bird, first seen and collected near Lukolela and Bolengi on the middle Congo, July 18 and 20, 1909, was observed thereafter only at long intervals, at Medje (Ituri District) in March, 1910, and again in July, 1910. The reason for these irregular appearances, as we learned later, was the simple fact that the species was found in the forest region only during migration, spending the greater part of the year in the open country to the north, east, and south.

The following October we left the Ituri Forest, and came out into the more open upper Uele District; but even here this particular nightjar was not to be seen, although Judge Smets spoke of having seen such a bird at Niangara in July previous. It was not until March that our goatsucker reappeared, this time in numbers. But the adult males at this season showed no long plumes, not because they had moulted, but simply because the old feathers now projected little beyond the neighboring remiges, having been *broken off* short, as a result no doubt of wear and accidents amid the grass, aided by the brittleness of the shafts. Besides adults of both sexes, there were often individuals still in juvenal plumage.



SEASONAL DISTRIBUTION OF COSMETORNIS VEXILLARIUS

From now on the species was common until August. The long plumes of the males were molted in May. Here Woosnam's[1] observations agree with mine, and I doubt the accuracy of the statement in Stark and Sclater's 'Birds of South Africa' that they are shed in December or January. So long a time is required for the complete development of these feathers that the basal sheath is often still present in August.

Their habits are worthy of brief mention. As might be expected, they spend the day on the ground, but will fly up if disturbed, and then occasionally alight even in small trees. Like other members of the family, they begin to feed at dusk, and during the middle of the night often sit on open spots along roads and the like, taking wing again to feed just before dawn. But unlike many other nightjars, they are, we found, practically mute.

Of the fat, winged termites ("white ants") which fly in such great numbers in this region from April to August, they are very fond. Indeed, the real cause of the migration we are studying may very possibly be traced to their appetite for these particular insects, which tempt so many other African birds, and are esteemed even by the negroes. When the termites are swarming from their nests during the evening, the Pennant-winged Nightjars will sometimes gather in large flocks to catch them; as a result they acquire a heavy subcutaneous layer of fat, which, coupled with the tenderness of the skin and the weak attachment of the feathers, renders them exceedingly difficult to prepare for the collection.

In June they had taken to flying high in the air during the early evening, often in pairs as though mated. But there was no sign of their breeding; the reproductive organs were in a quiescent state, and neither eggs nor nestlings ever came to our notice. By the first of September the species had disappeared almost completely. The rains were by no means finished, but continued till late November. Where had they gone?

The following year all this was repeated. Prof. Reichenow's 'Vogelfauna des Mittelafrikanischen Seengebietes,' a copy of which I owed to the kindness of Dr. Schubotz, gave their range as "all tropical Africa." During three seasons, 1911, 1912, and 1913, we observed them regularly in the Uele District from March to August. Where did they spend the rest of the year?

By 1914 I was back again in the Ituri forest, at Avakubi, where in late February and March the birds reappeared, adult males with broken plumes, and young in juvenal plumage; and once more in July and August, the males now with long streamers. It occurred to me therefore that they must breed in the open regions south of the forest, and then migrate northward across the forest to spend the months from March to July and August in the Sudan and Uele, and probably Uganda, returning to their breeding grounds by recrossing the forest.

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[1] Transactions of the Zoological Society of London, 1910, p. 430.

On my way home I had the good fortune to meet an old acquaintance, Mr. F. DeCock, of the Belgian Agricultural Service, whom I had first known at Faradje, in the Uele, in 1911, and who had spent many an evening with me in pursuit of these very birds. Since then he had lived for a year at Nyangwe, on the Lualaba River at the southern edge of the forest; and he was able to furnish the very information I needed. The Pennant-winged Nightjar arrived at Nyangwe towards September.

The conclusions reached at that time have since been thoroughly confirmed by an examination of the published records in so far as they are accompanied with dates, in Reichenow's 'Vögel Afrikas' and 'Vogelfauna des Mittelafrikanischen Seengebietes,' Stark and Sclater's 'Birds of South Africa,' 'The Ibis' and elsewhere.

According to this evidence, *Cosmetornis vexillarius* has never been found breeding north of the equator, but only at the following localities and dates:

Lufuku River, west of L. Tanganyika,	Sept. 8	Böhm.
Mashonaland,	Sept. 28	Ayres.
Zambezi River	Nov.	Alexander.

As to the other published records, all those from September to January inclusive come from the southern part of the range, that is to say, south of the forest; as follows:

Malanje, Angola,	Sept.	Mechow.
Karema, Lake Tanganyika,	Nov., Feb.	Böhm.
Masembe, near Mpala, Lake Tanganyika,	Sept.	"
Kauwire, German East Africa (?),	Sept.	"
Kauebach, near southern end of Lake Tanganyika,	Sept.	"
Iringa, German East Africa,	Nov.	Stierling.
Songea, " " "	Oct.	"
Pembera, " " "	Oct.	Fülleborn.
Bukama, Katanga, Belgian Congo,	Sept.	Bequaert.
Lufupa River, Katanga, Belgian Congo,	Oct.	Neave.
Kalungwizi River, east of Lake Moero,	Sept.	"
Ndola, N. W. Rhodesia,	Oct.	"
Lake Nyasa,	Sept., Oct.	Kirk.
Mt. Somba, Nyasaland,	Sept., Jan.	Whyte.
Victoria Falls,	Jan.	Oates.
Umfuli River, Mashonaland,	Oct.	Jameson.
Ganyani River, "	Sept.	"
Bulawayo, Rhodesia,	Nov.	Douglas.
Chirinda, Gazaland,	Jan.	Swynnerton.
Umswirezi River, Gazaland,	Nov.	"
Elephant's Vlei, German S. W. Africa,	Oct.	Andersson.

But this is just the season, as our observations show, when it is entirely absent from the northern part. Published records from north of the forest are few, and those with dates decidedly rare:

Djur, Bahr-el-Ghazal,	no date	Schweinfurth.
Bongo, “ “ “	“ “	V. Heuglin.
Tingasi (near Niangara), Uele District,	July	Emin Pasha.
Semio, Uele District, Belgian Congo,	March	Bohndorff.
Loko, Nigeria,	July	Hartert.
Alhadjin Galibu, Adamaua,	May	Riggenbach.
River Benue, near Garua,	June	“
Kokumi, “ “	July	“

These may be supplemented with our own data:

Faradje, Uele District, Belgian Congo,	March 13 to Aug. 19 (regularly). Exceptionally on Sept. 3 and 26.
Nzoro, “ “ “ “	April to July.
Aba, “ “ “ “	July.
Garamba, “ “ “ “	May to July.
Niangara. “ “ “ “	March to July.

The only other data in the literature, from any part of Africa, from March to July, are the following, and none of them is from South Africa:

Mubuku Valley, Mt. Ruwenzori,	March	Ruwenzori Exp.
Mokia, southeast of Mt. Ruwenzori,	May, June, July	“ “
Toro, Unganda Protectorate,	March	Archer.
Ankole, “ “	July	Johnston.
Nguruman, German East Africa,	June	Fischer.
Kakoma, “ “ “	April	Böhm.
Malanje, Angola,	May	Mechow.
Aruwimi River, Belgian Congo,	July	Jameson.

Here a few words of explanation will be necessary. The first four localities are in Uganda, directly east of the Congo forest, close to the equator, and the dates of occurrence show that the birds are found ‘wintering’ there regularly, as well as to the north of the forest. Nguruman and Kakoma are further east and south, though hardly within the breeding range. Malanje, however, is beyond the southern border of the forest, proving that some birds do stay throughout the year in that part of the breeding range nearest the ‘winter’ range. But this is not in the least surprising.

The example reported from the Aruwimi, July, is of course an early migrant crossing the forest on its way south. The only other printed records, with dates, from the forest area that I have found are those of G. L. Bates (Ibis, 1907, p. 432; and 1909, p. 26); River Ja, Kamerun, March 5, 10, 16. He states expressly that it is not a resident; and it will be noted that these dates of migration agree perfectly with ours, which follow:

Lukolela, on the middle Congo,	July 18.
Bolengi, " " " "	July 20.
Avakubi, Ituri District, Belgian Congo,	Feb. 24, March 12, 20; July 23, Aug. 10, 16.
Medje, " " " "	March 6, 23; July 29.

In order to render these data more intelligible, they have been indicated on the accompanying map. With the exception of the forest region, all places of occurrence from the months of September to January, inclusive (*i. e.*, the breeding season), have been marked with a circle; all those from March to July inclusive with a cross. All the records for the months of August and February have of necessity been omitted, for at these periods of migration the birds are distributed more or less thoughout their whole range. Within the forest area, however, all the records have been included, those for February and March, on the northward migration, being represented by a ↑, those observed during the southward migration in July and August by a ↓.

The records which must, for the reasons stated above, be omitted from the map are as follows:

February.	
Mt. Ruwenzori,	Archer.
Kangao's, Toro, Uganda,	"
Karema, eastern shore of L. Tanganyika,	Böhm.
August.	
Karagwe, west of Lake Victoria,	v. Trotha.
Burumbu, southern Uganda,	Doggett.
Kissenji, Lake Kivu,	v. Stegmann.
Mpala, western shore of L. Tanganyika,	Böhm.
Malanje, Angola,	Mechow.
Milanji Highlands, Nyasaland,	Whyte.
Mashonaland.	Jameson.
Two exceptional records. Faradje, Uele District, Sept.	Chapin.

In conclusion then, we may state that this strictly tropical nightjar, *Cosmetornis vexillarius,* migrates back and forth across the equator twice a year. In September, October, and November it breeds from Angola and Lake Tanganyika to Damaraland and the Transvaal; and in February migrates northward to Uganda and the grass-country of the Uele, the Sudan, and Nigeria. The records show that in East Africa the line dividing the breeding and non-breeding parts of the range is apparently from 3 to 5 degrees south latitude, and that a few birds remain at all seasons at the northern edge of the breeding range; the majority, however, migrate further northward, even crossing the great West African forest to seek the open country they prefer, and thus they enjoy the best seasons for winged termites in both sections.

Surely a question has already suggested itself to the reader: Are there other cases of such migration in Africa? No doubt there are. On the other hand, however, some migrations seem to be mere extensions of range at certain seasons. Taking for example the related goatsucker, *Macrodipteryx macrodipterus,* the male of which has a long racquet-tipped feather in each wing, we find that it ranges from Senegal to Abyssinia, north of the forest, only reaching the equator in Uganda. In the Uele District we noticed that it appeared regularly about December 1, at the beginning of the dry season, but before the burning of the grass. It would lay its eggs, rear its young, and then, at the commencement of the rainy season — early April — disappear again, doubtless withdrawing to the northward. Here, too, it may be noticed that the breeding ranges of *Macrodipteryx* and *Cosmetornis* are more or less complemental; the one north, the other south of the equator.

59.9(8)

Article XI.— NEW SOUTH AMERICAN MAMMALS.

By J. A. Allen.

Metachirus nudicaudatus antioquiæ subsp. nov.

Type, No. 37751, ♂ ad., La Frijolera (altitude 5000 feet), Antioquia, Colombia, Jan. 1, 1915; L. E. Miller and H. S. Boyle.

Upperparts very dark, strongly varied with black along the middle of the back; ventral surface, cheeks and supraorbital spots ochraceous buff; outside of tarsus black.

Total length, 600 mm.; head and body, 288; tail vertebræ, 312; hind foot, 50. Skull, condylobasal length, 62; zygomatic breadth, 33; interorbital constriction, 9.5; nasals, 35 × 9.5; upper toothrow (canine to last molar inclusive), 22.5; molar series, 12; breadth of palate at last molars (outside to outside of teeth), 24.5.

The type (and only specimen) is an old male in good pelage and with worn teeth.

This is much the darkest and most richly colored form of the *M. nudicaudatus* group thus far described. In comparison with four topotypes of *M. n. dentaneus* from the Panama Canal Zone, it is much darker above and the underparts are deep orange. *M. n. columbianus*, from the Santa Marta district, on the other hand, is much paler than *dentaneus*.[1]

Tamandua tetradactyla punensis subsp. nov.

Type, No. 36452, ♀ ad., Puna Island, Ecuador, April 7, 1913; William B. Richardson.

Skull very broad relatively to the length, with very broad short nasals.

Upper surface of body intense black, this color extending nearly to the base of the tail, and continued as a broad band laterally downward and inward in front of the shoulders; head, neck, limbs and a narrow median dorsal band, from between the shoulders to the loins, buffy white, the hairs more or less dusky at base on the foreneck, breast, limbs and base of tail, elsewhere yellowish white to the base; ventral surface black from breast to base of tail; apical three fourths of tail naked and black.

Collector's measurements of type (a 'young adult' female): Total length, 1300 mm.; head and body, 760; tail, 540; hind foot, 90. Skull (type), occipitonasal length, 115; condylobasal length, 118; breadth at lacrymals, 33; interorbital breadth, 25; breadth of braincase, 40; mastoid breadth, 35; nasals, length 40, breadth at front border, 10, least breadth 8, breadth at posterior border 14.3. An old female skull from Guayaquil, occipitonasal length, — ; condylobasal length, 122; breadth at lacrymals, 37; interorbital breadth, 27; breadth of braincase, 42.3; mastoid breadth, —; nasals, length 45, breadth at front 9, least breadth 8, breadth at posterior border 15.

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[1] In 1908 (this Bulletin, XXIV, p. 648), I referred a specimen from Chontales, Nicaragua to *M. n. columbianus*, with the remark that further material may indicate "that the forms from the regions [Santa Marta and Nicaragua] are subspecifically separable." Four years later *M. n. dentaneus* was described from Panama by Mr. Goldman, and it is to this form that the Nicaragua specimen should be referred.

Two additional specimens, an old female and a quarter grown young, from Guayaquil are also referred to this form. The pattern of coloration in the young specimen is the same as that of the type, but the dark area is blackish brown instead of intense black. The coloration of the old female is evidently erratic, the black of the upperparts being greatly restricted, occupying a small area on the thoracic region, from which the shoulder bands, also reduced in size, are widely separated by an area of yellowish white. The black of the back and ventral surface is more or less obscured by many of the hairs being white-tipped.

Subspecies *punensis* is not closely related to its nearest geographical ally, *M. t. chiriquensis,* which apparently extends southward through the Western Andes of Colombia, it differing from it notably in smaller size and in a relatively much broader skull and much shorter and broader nasals.

Sylvilagus boylei sp. nov.

Type, No. 37794, ♀ ad., La Playa, near Barranquilla, Colombia; L. E. Miller and H. S. Boyle, March 25, 1915. Altitude, 150 feet.

Whole top of head bright light cinnamon; nape chestnut rufous; a broad whitish gray eyering; cheeks fulvous grizzled slightly with black-tipped hairs; middle of back grizzled black, dark chestnut and yellowish white, the hairs dark plumbeous at base, ringed narrowly with black, followed by a broad band of yellowish white, and tipped partly with black and partly with dark chestnut, giving the general effect of black variegated with chestnut and whitish; sides much lighter and much less varied with black; tail above like the back, below white; chin, upper throat, chest and belly white; breast band ochraceous buff; fore arm pale rufous, forefeet buff, inside of fore limbs with a narrow whitish band; hind feet anteriorly with a narrow band of whitish, side pale cinnamon rufous; ears dusky, passing into black apically and edged narrowly with white.

Total length, 440 mm.; tail vertebræ, 35; hind foot, 90 (82 in dry skin); ear, 68. The skull appears to have been lost in transit.

S. boylei needs no comparison with *S. nigronuchalis continentis* Osgood from vicinity of Maracaibo, nor with *S. cumanicus* (Thomas), nor is it closely related to the *S. gabbi* group.

Cavia (Cavia) anolaimæ sp. nov.

Type, No. 37358, ♂ ad., Anolaima, on a branch of the Rio Bogotá, west of Bogotá, Colombia, Sept. 8, 1913; Manuel Gonzalez.

Size very large; hind foot, s. u., 50, c. u., 62 mm. Coloration uniform dark yellowish gray in general effect, except on the ventral surface, the exposed portion of the hairs being black with a narrow subapical band of pale olivaceous buff; ventral surface dingy brownish gray, the hairs of a uniform tone to the base; no white around eyes or ears. Total length (from skin), 335 mm.; hind foot 50, with claws 62; height of ear from crown, 20, by 25 in breadth.

Skull (broken at base), total length, 66 (?); zygomatic breadth, 38; nasals, 22.5 × 11; tip of nasals to fronto-parietal suture, 46; palatal length, 35; maxillary toothrow, 16. The skull in size and general form closely resembles that of the domestic Guiney pig (*Cavia porcellus*).

Represented by a skin and skull and an additional skull. The skulls are much broken posteriorly; both are skulls of very old males, and agree in size and in heavy ossification, the upper border of the orbits being fringed with projecting serration of bone.

In general coloration of the upper parts this species greatly resembles *Cavia aperea azaræ* from Rio Negro, Patagonia, but it is darker above and the ventral surface is sooty gray instead of white. It is also much larger.

Oryzomys barbacoas sp. nov.

Type, No. 34193, ♂ ad., Barbacoas, altitude 75 feet, southwestern Colombia, August 10, 1912; Wm. B. Richardson.

Pelage lustrous, short and thick, about 12 mm. long on the back. Upperparts, in general effect, chestnut, the hairs being plumbeous nearly to the tips, with an apical band, about 2 mm. broad, deep ochraceous rufous, the extreme tips of the hairs black; sides and cheeks ochraceous rufous, the hairs without black tips; ventral surface heavily washed with ochraceous yellow, forming the prevailing color, the hairs dusky at base; top of head like the back, darkening slightly on the nose; feet nearly naked, dusky brownish, the scales strongly visible, especially on the hind feet, which have a few very thin brownish hairs at the base of the nails; ears small, black, naked, only about one half exposed beyond the fur; tail dark brown, naked, slightly longer than the head and body.

Skull short, broad and heavy, supraorbital ridge very heavily developed, extending to the parieto-occipital suture, where it descends to the ear as in *Sigmodon;* dentition heavy, but otherwise, as also the skull, as in typical *Oryzomys*.

Total length (type), 300 mm.; head and body, 140; tail vertebræ, 160; hind foot (c. u.), 35, broad and heavy; ear (in dry skin), 15. Adult female topotype, total length, 310; head and body, 150; tail vertebræ, 160; hind foot, 35; ear, 15. A young adult male (topotype) is slightly smaller and has the coloration much duller and paler, lacking the vivid tone of the adults.

Skull (type), total length, 36; zygomatic breadth, 20; interorbital breadth, 6.3;

breadth of braincase, 14; mastoid breadth, 12; palatal length, 19; maxillary toothrow, 5.5; palatal foramina, 4 × 2; diastema, 10. Adult female (topotype), total length, 36; zygomatic breadth, 18.5; interorbital breadth, 6; breadth of braincase, 14; mastoid breadth, 12; palatal length, 19; maxillary toothrow, 6; diastema, 9.8.

Similar in a general way to *Oryzomys bolivaris* Allen of central Ecuador but much larger with the belly ochraceous instead of white. It is strongly distinct from any member of the *Oryzomys albigularis-pectoralis* group, not only in cranial but in external characters, an obvious distinction being the absence of the tuft of white bristly hairs at the base of the toe nails of the hind feet, so conspicuous in all the different forms of the latter.

Glossophaga apolinari sp. nov.

Type, No. 37376, ad. (sex not indicated), Boqueron de San Francisco (altitude 2730 m. = 8900 ft.), near Bogotá, Colombia, December, 1909. Collected and presented by Brother Apolinar Maria, Director of the Instituto de la Salle, Bogotá, for whom the species is named.

Size very large, coloration blackish above and but little lighter below, without cinnamon brown tones. Upperparts dark blackish brown, darkest on the head, the hairs gray at base broadly tipped with blackish; underparts similar but slightly lighter, the extreme tips of the hairs grayish, giving in most specimens a faint grayish wash; membranes dark brown. Forearm (type), 43 mm.; third metacarpal, 45. Five specimens (type and 4 topotypes), forearm, 43 (42–44); third metacarpal 44 (43–45).

Skull long and slender, braincase lower and less inflated than in *G. longirostris longirostris*, rostrum relatively (as well as absolutely) much longer. Total length (type), 25; condylobasal length, 24; breadth of braincase, 14; length of rostrum (to posterior border of nasals), 10.5; length of upper toothrow (including canine), 9.6; maxillary toothrow, 8.6. Five skulls (type and 4 topotypes), total length, 24.4 (24–25); condylobasal length (3 skulls), 23.5; breadth of braincase, 14.3 (14–14.5).

Glossophaga apolinari is represented by five specimens, all from the type locality and all fully adult, but the sex is not indicated. It differs from all other known forms of the genus by its much larger size, and also in its much darker coloration, so far as represented by the present series. In view of the wide range of individual variation in color in the allied forms this latter feature may not be important, but the difference in size is significant, the forearm having an average length of 43 mm. against 37.3 in *G. elongata* [1] and 37.6 in *G. longirostris longirostris*,[1] the largest of the forms hitherto known. The condylobasal length of the skull is 23.5 against 22.5 in *G. elongata*, and 21.7 in *G. l. longirostris*.

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[1] Twenty specimens and 12 specimens respectively; measurements by Gerrit S. Miller, Jr., in Proc. U. S. Nat. Mus., Vol. 46, No. 2034, p. 429, Dec. 31, 1913.

Saimiri caquetensis sp. nov.

Type, No. 33874, ♂ ad., Florencia, altitude 1000 feet, Caquetá, Colombia, July 6, 1912; Leo E. Miller.

Similar in size and general coloration to *S. macrodon* Elliot, but limbs gray to wrists and ankles, only the hands and feet washed or strongly suffused with yellow.

Upper surface of head gray, the hairs tipped with whitish; sides of shoulders and outside of upper arms gray; forearms externally gray, the hairs subapically suffused with yellow, increasing in intensity to tawny on the toes; midregion of the back, from between the shoulders to base of tail, dark tawny, the hairs tipped strongly with black, giving the general effect of blackish tawny; sides more golden and less washed with blackish; sides of head and whole ventral surface pale yellowish white, nearly clear white on sides of head, throat and chest and upperpart of inside of limbs, more yellowish on the belly and lower part of inside of hind limbs; hind limbs externally pale olive gray in general effect, the main color being gray strongly suffused with yellowish; feet more heavily suffused with yellow, passing into grizzled tawny on the toes; tail blackish tawny (like back) at extreme base, then gray to the black apical third.

External measurements of type (from a well-made skin): Total length, 770 mm.; head and body, 370; tail vertebræ, 400; hind foot, 84. Skull (type), total length, 63; occipitonasal length, 60; condylobasal length, 44; zygomatic breadth, 39; breadth of braincase, 37; orbital breadth, 35; postorbital breadth, 31; nasals 8 × 2.5; maxillary toothrow, 12; maxillary toothrow with canine, 16. The type is a fully adult male; the skull of an older topotype male is slightly larger (condylobasal length 45, zygomatic breadth 40).

Saimiri caquetensis differs from *S. sciureus* (Pará specimens) in much larger size (skull about 6 mm. longer, zygomatic breadth 3 mm. greater), in the lighter and less suffused gray of the head and shoulders, the very much richer and darker tawny of the back, and the absence of the deep tawny on the lower legs and arms so characteristic of *sciureus*. It appears to be more nearly related to *S. macrodon* Elliot, at least in size and general coloration, but lacks the heavy dentition ascribed to that species, nor has it "much darker forearms, hands and feet," in comparison with *sciureus*, these being lighter and very much less tawny than in *sciureus*.

Besides the type and topotype from Florencia, I refer to this form three specimens from Barrigon (Cundinarmarca, near Bogotá, at head of navigation on the Rio Meta), they being indistinguishable from the Florencia specimens. Hence this form is in all probability the *Saimiris sciureus*, var. *c*, of I. Geoffroy,[1] the basis of Elliot's "Santa Fé de Bogata" record for *S. sciureus*.[2]

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[1] Cat. meth. des Mamm., 1851, p. 38.

[2] Rev. of Primates, I, p. 311.

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Article XII. — THE NEOTROPICAL WEASELS.

By J. A. Allen.

CONTENTS.

Page.

Introduction 89
  Historical résumé 90
Color variations in the *Mustela tropicalis* group 91
  Facial markings 92
  Light markings on the feet 96
  Seasonal and age variation in color 97
  Summary 97
The status of *Mustela affinis* Gray 98
Systematic review of the species and subspecies 99

Introduction.

In attempting recently to identify the South American weasels in the American Museum of Natural History it soon became evident that those of South America were so intimately related to those of Central America and Mexico that it was necessary to take them all into consideration. The present paper is the outcome of this investigation. The material available for study (about 75 specimens), while insufficient for a satisfactory revision of the group, throws much light on the interrelationships of the various forms.

For important material kindly loaned for use in this connection I am greatly indebted to Mr. Gerrit S. Miller, Jr., Curator of the Division of Mammals, United States National Museum; Mr. E. W. Nelson, Acting Chief, Bureau of Biological Survey; Mr. Samuel Henshaw, Director of the Museum of Comparative Zoölogy at Harvard University; and Mr. Wilfred H. Osgood, Curator of Mammals, Field Museum of Natural History, Chicago. I am also especially indebted to Mr. Edmund Heller, of Washington, D. C., for 4 specimens collected by him north of Cuzco, Peru, while on the Yale-National Geographic Peruvian Expedition, 1914–1915.

This material includes the types of *Mustela tropicalis* (Merriam), *M. t. perda* (Merriam), and *M. costaricensis* Goldman, and the paratype and topotype material on which these forms were originally based. Also specimens referred at different times and by different authors to *M. affinis* Gray, and a large series of topotypes of *M. meridana* Hollister.

The weasels of Central and South America are at present poorly represented in museums and are consequently very imperfectly known, either as regards the range of the group as a whole or in respect to the number and distribution of the forms. Their range appears to be mainly subtropical and temperate, with the single exception of two species thus far known only from portions of the tropical lowlands of the Amazonian basin.

The weasels of southern Mexico and southward in the highlands of Central America and of northern and western South America (Venezuela, Colombia, Ecuador and Peru) are all closely related, though the northern forms differ rather strikingly from the southern in the color pattern of the head, but the change is progressive from the north southward, the white face markings, so conspicuous in *Mustela tropicalis,* gradually becoming obsolete in Costa Rica and Panama, with a gradual darkening of the general coloration. A second group, characterized by smaller size, relatively shorter tail, and much lighter coloration, occurs in Ecuador and Peru, while a third group, characterized by very large size and a distinctive color pattern, is known only from parts of Amazonia.

Historical Résumé.

The hitherto described forms of tropical American weasels may be listed, in chronological order, as follows:

1844. (1) *Mustela agilis* Tschudi. Type locality, Andes of Peru.
1864. (2) *Mustela aureoventris* Gray. Type locality, Quito, Ecuador. Not *Mustela auriventer* Hodgson, 1841. *Putorius* (*Gale*) *brasiliensis* var. *æquatorialis* Coues (Fur-Bearing Animals, 1877, p. 142) is "merely a substitute for Gray's preoccupied name."
1874. (3) *Mustela macrura* Taczanowski. Type locality, near Lake Junen, central Peru.
1874. (4) *Mustela affinis* Gray. Type locality, "New Granada" = Bogotá region, Colombia (*cf. postea,* p. 99).
1881. (5) *Mustela jelskii* Taczanowski. Type locality, Cutervo, Peru.
1881. (6) *Mustela stolzmanni* Taczanowski. Type locality, Yurimaguas, northeastern Peru.
1897. (7) *Mustela paraensis* (Goeldi). Type locality, Pará, Brazil.
1898. (8) *Mustela tropicalis* (Merriam). Type locality, Jico, Vera Cruz, Mexico.

1902. (9) *Mustela tropicalis perdus* (Merriam). Type locality, Teapa, Tabasco, Mexico.
1912. (10) *Mustela costaricensis* Goldman. Type locality, San José, Costa Rica.
1914. (11) *Mustela meridana* Hollister. Type locality, Sierra de Merida, Venezuela.

The only addition to this list in the present paper is *Mustela tropicalis nicaraguæ* (*postea*, p. 100), from Matagalpa, Nicaragua.

The name *Mustela brasiliensis* Sevastianoff (1813), supposed by its author to have been based on a specimen from Brazil, proves to have been founded on a Mexican species described nineteen years later by Lichtenstein as *Mustela frenata,* from a specimen taken in the Valley of Mexico.[1] It is thus fortunate that Sevastianoff's name was preoccupied by *Mustela brasiliensis* Gmelin (1788) for a Brazilian otter. Yet *Mustela brasiliensis* was current during the middle of the nineteenth century for a supposed Brazilian weasel with conspicuous white face markings, to which all the weasels of Mexico and Central and South America were at one time referred.[2]

Mustela sinuensis Humboldt,[3] from the Rio Sinu, Colombia, I am unable to identify as a species of *Mustela.*

The first weasel really described from a South American specimen was *Mustela agilis* Tschudi (1841); as stated by Baird,[4] this was the only South American weasel known prior to 1857. No weasel was known from Brazil till 1897, when Goeldi published his *Putorius paraensis.*[5] The second South American species was described by Gray, from Quito, Ecuador, as *Mustela aureoventris* in 1864.[6]

Color Variations in the Mustela tropicalis Group.

Prior to the description of *Mustela tropicalis* by C. Hart Merriam, in 1896,[7] all of the weasels of North and Central America with a black head conspicuously marked with white were referred either to *Mustela brasiliensis* Sevastianoff or to *Mustela frenata* Lichtenstein. The true *Mustela frenata* group ranges from Texas and New Mexico southward through eastern

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[1] *Cf.* C. Hart Merriam's 'A Note on *Putorius brasiliensis*': North Amer. Fauna, No. 11, pp. 27–28, June 30, 1896.

[2] *Cf.* Coues, Fur-Bearing Animals, 1877, p. 142; Alston, Biol. Centrali-Americana, Mamm., 1880, p. 79; True, Proc. U. S. Nat. Mus., VII, 1884 (1885), p. 610.

[3] Rech. Zool., I, 1811, p. 348.

[4] Mammals of North America, 1857, p. 174.

[5] Zool. Jahrb., X, Heft. 4, pp. 556–568, pl. xxi, Sept., 1897.

[6] Proc. Zool. Soc. London, 1864, p. 55, pl. viii, June, 1864.

[7] North American Fauna, No. 11, p. 30, pl. iii, figs. 5, 5*a*, 6, 6*a*, and text fig. 16, June 30, 1896.

Mexico to Michoacan and Chiapas, thus overlapping the range of *Mustela tropicalis.* While *frenata* and *tropicalis* present a remarkable similarity in the color pattern of the head and in general coloration, and while their ranges slightly overlap, they are surprisingly distinct in cranial characters. In *frenata,* besides other important differences, the postorbital constriction is very deep and angular in front through the great development of the postorbital processes, so that the postorbital breadth of the skull is much less than the interorbital breadth; in *tropicalis* the postorbital breadth exceeds the interorbital, and the postorbital processes are only slightly developed. As noted by Merriam (*l. c.*, p. 30), the postorbital region of the skull in *frenata* resembles that of *M. longicauda,* while the same region of the skull in *tropicalis* resembles that of *M. noveboracensis.* *M. frenatus* is also a larger species than *M. tropicalis.*[1]

Facial markings. The color pattern of the head in typical *tropicalis* consists of conspicuous white markings on a black ground,— a large square white patch between the eyes, and an oblique broad white band on each side of the head in front of the ears, extending upward from the white area of the throat to above the posterior corner of the eye, confluent with the white on the throat but not quite meeting the white interorbital patch. The type form of the group is represented in the present material by the type and three paratypes and by three other specimens from near the type locality, seven specimens in all. The type conforms to the above description, from which the paratypes vary as follows: (*a*) frontal spot divided into two spots connected by scattered white hairs; (*b*) frontal spot small; (*c*) frontal spot and lateral bands strongly developed, but the latter much reduced in width as they approach the throat.

Other specimens from the type region (vicinity of Jalapa) include two from Perez and one from Trujillo. The two Perez specimens, both males, differ widely from each other; in one the frontal spot is large and the oblique lateral bands are very broad and confluent both with the white of the throat and with the frontal patch. In the other the frontal spot is reduced to a thin V-shaped mark; the lateral bands are narrow and short, separated from the white of the throat by a broad space of black; the band on the right side is much narrower than the one on the left, and occupies only about one-tenth of the normal area of the lateral bands. The Trujillo specimen has the frontal spot greatly reduced and almost divided into two, while the lateral bands are very broad and confluent with the white of the throat and with the frontal spot.

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[1] *Putorius macrophoneus* Elliot (Proc. Biol. Soc. Washington, XVIII, p. 235, Dec. 9, 1905) is a subspecies of the *M. frenata* group (type and topotype examined).

A series of four specimens from Guatemala (three without definite localities) compare as follows with the Vera Cruz specimens: Two have the head markings all heavily developed, with the lateral bands confluent with the frontal patch and with the white of the throat; in one all the white markings are greatly reduced in breadth and the lateral bands do not reach the frontal patch; in the other the frontal mark is reduced to a small V-shaped spot and the lateral bands are reduced to one third of the normal breadth.

A series of six specimens from northern Nicaragua (5 from Matagalpa and 1 from San Rafael) vary as follows: In three the white lateral bands are confluent with the white of the throat but do not reach the small white frontal area. In the fourth specimen the lateral stripes are broad but do not extend to the throat nor reach the white frontal area. In the fifth the lateral stripes are very narrow, and do not extend below the middle of the ear, nor reach the frontal spot, which is also reduced to a narrow transverse line. In the sixth the lateral stripes are reduced to a small oval spot in front of the middle of each ear, while the frontal spot is of normal size and nearly quadrate.

Costa Rica specimens are, as a rule, practically without white markings, the whole head being black, with or without a few white hairs in the areas usually white in specimens from Nicaragua and further north. Four Costa Rica specimens (one from San José, the others without definite locality) vary individually as follows: One (No. 13770, Nat. Mus.) [1] has no white on the head; another (No. 16262, Nat. Mus.) has a few white hairs between the ear and eye on both sides of the head, a few more on the left side than on the right, but not enough on either side to be very noticeable; a third (No. 11409, Nat. Mus.) has many white hairs between the ear and eye on the right side and a few in the same position on the left; the other (No. 12891, Nat. Mus.) has a large patch of white hairs on the right side between the ear and the eye, two small tufts of white hairs on the left side between the ear and eye, two white tufts of white hairs on the left side in the same position, and a few white hairs between the eyes, representing the white frontal spot.

Three additional specimens from Costa Rica are recorded by Dr. von Frantzius,[2] the only ones, he says, he saw during several years of collecting in that country. These he says had no white markings on the face.[3] Gray [4] also cites a specimen from Costa Rica in the British Museum in which "the head is entirely blackish, without any white spot or streak whatever." Alston,[1] however, refers to a specimen from Costa Rica, in the British Museum, in which the white face markings "are of the usual size." Granting that the locality of Alston's specimen is correctly recorded, seven out of eight Costa Rica specimens have the white markings on the head either wanting or vestigial.

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[1] Type of *Mustela costaricensis* Goldman.

[2] Archiv für Naturg., XXXV, 1869, pp. 286–287.

[3] He says: "Es stimmt in seiner Lebensweise mit dem gemeinen Wiesel (M. vulgaris Erxl.) überein, ist aber grösser als dieses und der *M. frenata* Lichtenst. sehr ähnlich, nur fehlen ihm die weissen Querstreifen im Gesicht, auch ist das Braun etwas dunkeler als bei jener Art; die unterseite ist gelb" (*l. c.*).

[4] Ann. and Mag. Nat. Hist. (4), XIV, p. 374, Nov. 1874.

Of eight specimens from Boquete, Chiriqui, now before me, three have the head wholly black and three have small tufts of white hairs between the ear and eye on both sides of the head, but usually with more white on one side than on the other, the white hairs being asymmetrically distributed. Another has two small tufts of white hairs on the left side only, in the area of the usual white stripe. Still another has a small white spot between the eyes, a large white band of irregular shape and 27 × 19 mm. in extent in front of the right ear, a small white spot behind it, and a few white hairs in front of the left ear.

Gray, writing many years ago,[2] under the heading "*Mustela brasiliensis,*" said: "There are specimens from Veragua, Guatemala, and Costa Rica, which have a white spot on the forehead between the eyes, and an oblique white streak from the back of the orbit to the front and underside of the ears; these spots and streaks vary in breadth. One specimen, from Veragua, has the head blackish brown, and with only a very indistinct white spot in front of the ears; and another from Colombia, has only the small white spot on the forehead just between the eyes, and none on the side of the head. . . . "

Of two specimens from Panama, one (from Rio Indio, near Gatun) has no white on the head, the other (from Mt. Pirri) has a small white spot in front of the right ear and a much larger one (25 × 40 mm.) in front of the left ear.

From the foregoing it is evident that the weasels of the *tropicalis* group have, as a rule, well developed white face markings, from Vera Cruz southward (so far as known) to northern Nicaragua, with lapses through individual variation toward obsolescence; and that in central Costa Rica and in Panama these markings become vestigial. How gradually and under what conditions this change takes place is at present unknown, owing to lack of material from the intermediate regions.

South of Panama the *tropicalis* group ranges through the Western Andes of Colombia into Ecuador, and eastward along the Caribbean coast mountains of Venezuela to at least as far as Caracas, and in the Andean system to Bogotá and Merida. While available specimens are few from this wide area, those in hand suffice to show that the face markings of the *tropicalis* phylum appear vestigially with considerable frequency, and are not wanting even in the weasels of Peru, which in some other respects, as in lighter general coloration and less blackish head, show some departure from the *tropicalis* standard. The following details, from such material as is now available, are therefore of interest.

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[1] Biologia Centrali-Americana, Mamm., p. 79.

[2] Ann. and Mag. Nat. Hist. (4), XIV, p. 374, Nov., 1874.

Three male specimens from Antioquia, Colombia (2 from Sta. Elena and 1 from Barro Branco); a male from Munchique (Upper Cauca region) and another male from Gualea (Ecuador), have each a few white hairs on the head in the areas which are white in the northern stock. A female from Miraflores and two females from Rio Zapata (all in the Upper Cauca region) have tufts of white hairs in front of the ear on one or both sides of the head, while one of them has also white hairs between the eyes, in the region of the frontal white spot.

Five specimens from the Bogotá district all have white hairs on the head, as follows: No. 37178, a few white hairs between the eyes and in front of the ears; No. 38493, white hairs sparsely scattered through the areas of the lateral white bands but none between the eyes; No. 34545 has an incipient white stripe on the left side, small tufts of white hairs on the right side, and a few white hairs above the right eye; No. 35804 has a large white frontal spot between the eyes, and a large area of white in front of each ear, confluent on each side of the head with the white on the throat. Two of the specimens also have scattered white hairs on the back of the neck and on the fore feet.

Of fifteen specimens from the Sierra de Merida, Venezuela, seven have incipient lateral stripes on the head and eight have the head wholly black or with only a few white hairs scattered through the areas of one or both of the lateral stripes. Thus, No. 21342 has a vestigial white spot between the eyes and a small spot of white in front of the middle of each ear; No. 21341 has a vestigial frontal white spot, and a large white spot on each side extending from the white of the throat to above the level of the upper border of the ear; No. 24311 has no white between the eyes, but on the right side is a white spot 10 by 4 mm. in extent between the ear and eye, and on the left two small tufts of white hairs between the ear and eye; No. 21343 has a narrow transverse band between the eyes, and a large area of white in front of each ear, confluent with the white on the throat. No. 18205, Field Mus. has a large white spot in front of the left ear and a smaller white spot in front of the right ear. It is of interest to note that these five specimens have more white on the head than do most of the specimens in a series of eight from Chiriqui.

It is further interesting to note that nearly all the weasels thus far described from Ecuador and Peru (*Mustela agilis* Tschudi, *M. macrura* and *M. jelskii* Taczanowski, and *M. aureoventris* Gray), are recorded as having small white spots on the side of the face between the eye and ear, on one or both sides.

Of two specimens (type and topotype) of *Mustela macrura* Taczanowski,[1] from near Lake Junin, central Peru, one is mentioned as having a small frontal spot of white, the other none. Lönnberg[2] records two specimens from Zambiza, Ecuador, one of which has a narrow white band running from the eye backward and downward to the white on the throat, while the other has only a trace of such a mark on one side.

Two specimens (Nos. 1644 and 1645) from Ambato, Ecuador, have each a white spot or a tuft of white hairs on each side of the face between the ear and eye, which in one forms an elongate white spot, 13 by 7 mm. in extent on the left side, while there are also a few white hairs in the region of the frontal spot.

A single specimen from San Esteban, Venezuela (near Caracas), has a few white hairs in front of each ear, a few between the eyes, and a few on each fore foot.

Light markings on the Feet. In the type and topotypes of *Mustela tropicalis* the light color of the underparts extends down the inside of the limbs to the feet, and in addition the toes of the fore feet are yellowish white for the greater part of their length. The original series of four specimens presents much individual variation in the amount and tone of the light color on the feet, paralleling the variation in the white markings on the head and correlated with it. Thus the individuals with most white on the head have also the largest amount of the light color on the feet. The same parallelism holds also in a geographic sense, the white markings on the feet disappearing as the facial markings recede, as would be expected on general principles.

In the type of *tropicalis* the fore feet are entirely buffy white; in the topotypes only the toes are thus colored, and there is less buffy space on the hind feet. In a male from Perez, in which all the white markings are greatly reduced, only the tips of the fore toes are blotched with fulvous and the hind feet are entirely dark brown. In the Guatemala series (only two specimens retain the fore limbs), the apical half of the toes is light colored in one, and in the other (with reduced head markings) the light color on the fore feet is restricted to a small blotch on the inner edge of the middle of each foot.

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[1] Proc. Zool. Soc. London, 1874, p. 311.

[2] Arkiv för. Zool., VIII, No. 16, p. 21, July 12, 1913.

In six specimens from Matagalpa, Nicaragua, five have small yellowish white blotches, irregular in shape and position, on one or both fore feet; the one without light spots on the feet is the one with least white on the head. In the dark Costa Rica and Chiriqui series the feet are entirely dark brown like the body.

Typical *tropicalis* also has the upper lip edged with white, while in *nicaraguæ,* and in all the forms of *affinis,* the dark color of the head extends to the commissure.

Seasonal and age variation in color. The four specimens of the type series of *Mustela tropicalis* were all in faded and worn pelage, the dates of collecting being July 5 (type), July 3, June 26, and May 2. These strongly contrast with specimens taken near the type locality in April and March, the former being many shades paler and in much shorter coat than the latter.

Young specimens, during the acquisition of the permanent dentition, are much more richly colored than the adults, particularly on the ventral surface, which is deep ochraceous orange instead of ochraceous buff (or even paler) as in old adults.

Summary. No specimens, nor descriptions of specimens, collected in any part of the wide area between Matagalpa in northern Nicaragua and San José in central Costa Rica, are available for consideration. But it seems probable that the transition from conspicuousness to obsolescence in the white face markings between northern Nicaragua and central Costa Rica is gradual and purely geographic. The similarity of specimens from central Costa Rica to those from Chiriqui, Veragua and other localities in Panama renders it almost certain that the same vestigial condition of the white face markings is practically continuous over the intervening districts.

Passing to South America, the first locality from which specimens are available is Antioquia, Colombia (3 specimens). The next is the Upper Cauca Valley (near San Antonio, at the southern end of the Western Andes of Colombia), from where one male and three females are available. A single specimen from Gualea, Ecuador, is not appreciably different from the above cited Colombia specimens. The whole series from western Colombia is, in fact, so similar to Costa Rica and Chiriqui specimens in size, cranial characters, and in general coloration, as to leave small basis for even subspecific separation of any portion of the series. The specimens from eastern Colombia and Venezuela are but slightly differentiated, although they have been separated specifically from the Central American forms. The first real break in the series occurs when the Peru-Ecuador forms are reached, which while differing slightly in size and in the general tone of coloration still retain traces of the white face marks which show their *tropicalis* descent.

The Status of Mustela affinis Gray.

Mustela affinis Gray [1] was based on a specimen from an unknown locality and was very imperfectly described. After referring to various specimens of weasels in the British Museum from Veragua, Colombia, Costa Rica and Guatemala, under the heading *Mustela brasiliensis,* he thus describes his *Mustela affinis:* "There is in the British Museum a large specimen of a weasel, from New Grenada of a dark brown colour, and rather darker head, which has a white line on the side of the head in front of the ears but no white mark on the forehead. It is most probably a distinct species; but its characters want confirmation.... It may be a variety of *brasiliensis.*"

When cited by later authors it was usually referred to *brasiliensis* till, in 1896, Dr. Merriam included it, as *Putorius affinis,* in his 'Synopsis of the Weasels of North America,' [2] identifying it with the series of weasels from Costa Rica previously referred to in the present paper (see *antea,* p. 93). The single specimen especially mentioned by Merriam (No. 13770, Nat. Mus.) became in 1912 the type of *Mustela costaricensis* Goldman.[3] Goldman in comparing *costaricensis* with allied forms, refers to *affinis* "as represented by specimens from various localities from Panama southward and including a series of 10 from Merida, Venezuela, identified by Mr. Oldfield Thomas and assumed to be typical."

Miller, late in the same year, included both *Mustela costaricensis* and *Mustela affinis* in his 'List of North American Mammals,' [4] assigning "Colombia" as the type locality, and adding: "Ranges north to Panama."

The name *Mustela* (or *Putorius*) *affinis* has been commonly applied in recent years to the weasels of both Colombia and Venezuela as well as to those of Costa Rica, but in 1914 Hollister named the Merida form *Mustela meridana.*[5]

The case of *Mustela affinis* Gray (not of Merriam or any later author) seems now to demand renewed consideration and, if possible, final settlement.

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[1] *Mustela affinis* Gray, Ann. and Mag. Nat. Hist. (4), XIV, p. 375, Nov. 1874.

[2] North Amer. Fauna, No. 11, p. 31, June 30, 1896.

[3] Proc. Biol. Soc. Washington, XXV, p. 9, Jan. 23, 1912. Type locality, San José, Costa Rica.

[4] Gerrit S. Miller, Jr. List of North American Mammals in the United States National Museum, p. 100, Dec. 31, 1912. = Bulletin 79, U. S. National Museum.

[5] Proc. Biol. Soc. Washington, XXVII, p. 143, July 10, 1914, Type locality, Sierra de Merida, Venezuela.

My first impression was that a type locality could only be found in Panama, and as Panama (at least Chiriqui) specimens are obviously not properly separable, even subspecifically, from Costa Rica specimens, *costaricensis* in that case would become a synonym of *affinis*. Later careful study of Colombia specimens revealed the fact that specimens from outside of Panama, particularly from the Bogotá district, satisfactorily met all the requirements of the description of *affinis*. The same is nearly true of the Upper Cauca region, but the latter seems not so likely to have been the source of Gray's specimen in the early days (prior to 1861) when New Grenada was the current name for the Colombia of later times, while Bogotá had long been a field well known to natural history collectors. It seems desirable as well as proper, therefore, to designate, as I now do, Bogotá, Colombia, as the type locality of *Mustela affinis* Gray. Gray's description calls for a large dark brown weasel with a rather darker head and "a white line on the side of the head in front of the ears but no white mark on the forehead." My five specimens from the vicinity of Bogotá fully meet these requirements and indicate that this is a common phase of coloration of the weasels of that immediate region.[1]

Systematic Review of the Species and Subspecies.[2]

Mustela tropicalis tropicalis (*Merriam*).

Putorius tropicalis Merriam, North Amer. Fauna, No. 11, p. 30, pl. iii, figs. 5, 5a, 6, 6a, and text fig. 16, June 30, 1896.

Putorius tropicalis perdus Merriam, Proc. Biol. Soc. Washington, XV, p. 67, March 22, 1902. Teapa, Tabasco, Mexico.

Type locality.— Jico, Vera Cruz, Mexico. Altitude, 6000 feet (1800 meters).

Geographic distribution.— Coast region of southeastern Mexico from Vera Cruz southward into Guatemala.

Putorius tropicalis was based on worn and faded summer specimens (type collected July 9), as shown by other specimens from the vicinity of the type locality collected in March and April. The type (and only known specimen) of *Putorius tropicalis perdus* was taken March 31, and is in the unworn dark pelage of early spring. The other slight differences characterizing *perdus* are of no significance in view of the wide range of variation in just these features in a series of seven specimens of typical *tropicalis*. (For measurements see Tables I and IV, pp. 106 and 108.)

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[1] Since writing the above I have learned from Mr. Oldfied Thomas that the type of *Mustela affinis* Gray is still extant in the British Museum, and I hope to soon have his opinion as to whether it could well have come from the Bogotá region.

[2] For Tables of Measurements see pp. 106–111.

Mustela tropicalis nicaraguæ subsp. nov.

Type, No. 30754, ♂ ad., Matagalpa, Nicaragua, April 16, 1910; Wm. B. Richardson. Altitude, 2000 feet.

Similar to *M. tropicalis tropicalis* but general coloration much darker and the white face markings somewhat reduced in area. (For measurements see Tables I and IV, pp. 106 and 108).

Mustela affinis affinis *Gray.*

Mustela affinis Gray, Ann. and Mag. Nat. Hist. (4), XIV, p. 375, Nov., 1874. Also, in part, of subsequent authors who have used the name.

Mustela meridana Hollister, Proc. Biol. Soc. Washington, XXVII, p. 143, July 10, 1914. Sierra de Merida, Venezuela.

Type locality.— "New Grenada" = vicinity of Bogotá, Colombia (*cf. antea,* pp. 99).

Geographic distribution.— Eastern Andes of Colombia, the Sierra de Merida, and the mountains of the Caribbean coast of Venezuela.

Somewhat smaller and less dark in the general coloration of the upperparts than *M. affinis costaricensis;* condylobasal length of the skull averaging about 7 mm. shorter, and the zygomatic breadth about 2 mm. less, than in *costaricensis,* with less extension backward of the dark color of the head. (For measurements see Tables II and VI, pp. 107 and 110).

Five specimens from the vicinity of Bogotá, two from the Paramo de Tama (Colombia-Venezuela boundary), two from the Caribbean coast of Venezuela, and fifteen from Sierra de Merida (topotypes of *M. meridana*) are referred to *affinis.* The Bogotá series is quite indistinguishable from the topotype series of *meridana,* and the few other specimens from northern Venezuela are not appreciably different. A large part of these specimens show traces of the white face markings so conspicuous in the ancestral stock, the *M. tropicalis* group of southern Mexico, Guatemala and northern Nicaragua.

Mustela affinis costaricensis *Goldman.*

Mustela brasiliensis Gray (not Sevastianoff), Ann. and Mag. Nat. Hist. (4), XIV, p. 374, Nov. 1874 (at least mainly). Also of most other authors prior to 1896.

Putorius affinis Merriam, North Amer. Fauna, No. 11, p. 31, June 30, 1896. Costa Rica. Also of most later authors between 1896 and 1912.

Putorius (*Ictis*) *affinis* Bangs, Bull. Mus. Comp. Zoöl., XXXIX, No. 2, p. 49, April, 1902. Boquete, Chiriqui.

Putorius macrurus Allen (not Taczanowski), Bull. Amer. Mus. Nat. Hist., XXXI, p. 91, April 19, 1912. Munchique and Miraflores, Cauca, Colombia.

Mustela affinis Miller, Bull. 79, U. S. Nat. Mus., p. 100, Dec. 31, 1912. "Ranges north to Panama."

Mustela costaricensis Goldman, Proc. Biol. Soc. Washington, XXV, p. 9, Jan. 23, 1912. Costa Rica.— Miller, Bull. 79, U. S. Nat. Mus., p. 100, Dec. 31, 1912 (ex Goldman).

Type locality.— San José, Costa Rica.

Geographic distribution.— Costa Rica and Panama, south through the Western Andes of Colombia to northwestern Ecuador (and Peru?).

Similar in general coloration and in size to the *M. tropicalis* group, but upperparts very much darker, and the white markings on head and feet absent or greatly reduced, usually to mere traces.

In addition to numerous specimens from Costa Rica, Chiriqui, and the Canal Zone of Panama, specimens from the following localities are referred to *costaricensis*: Antioquia, 3 males (2 from Sta. Elena, 1 from Barro Blanco); Cauca, 1 male, 3 females (Miraflores, Munchique, Rio Zapata); Gualea, Ecuador, 1 male. The specimens from Gualea and Munchique are in no way distinguishable from Boquete specimens.

An old female from Idma, Peru (altitude 6000 feet), collected by Mr. Heller (No. 761) agrees in size with females from the Western Andes of Colombia and in coloration with the large dark specimens from Gualea (Ecuador) and Munchique and northward in Colombia, and is hence referred provisionally to *costaricensis*. It is too large and too dark in coloration to be satisfactorily referable to *macrura*. It measures, total length 341, head and body 215, tail vertebræ 126, hind foot 43.

Mustela macrura *Taczanowski.*

Mustela aureoventris Gray, Proc. Zool. Soc. London, 1864, p. 55, pl. viii. Young male, Quito, Ecuador. Not *Mustela auriventris* Hodgson, 1841.

Mustela aureoventris Gray, Proc. Zool. Soc. London, 1865, p. 115 (part, only the reference to his previous description and type specimen; not the new material ("New Grenada" specimen) nor the description based on it.

Mustela macrura Taczanowski, Proc. Zool. Soc. London, 1874, p. 311, pl. xlviii. "Environs du lac Junin (Pérou central)." Adult male.

Putorius (Gale) brasiliensis var. *æquatorialis* Coues, Fur-Bearing Animals, 1877, p. 142 ("merely a substitute for Gray's preoccupied name," *i. e.*, *aureoventris*).

Mustela jelskii Taczanowski, Proc. Zool. Soc. London, 1881, p. 647. "Cutervo, au nord-est du Pérou." Adult female.

Mustela affinis and ?*Mustela macrura* Lönnberg, Arkiv för Zool., VIII, No. 16, p. 21, June, 1913. Respectively from Zambiza and Panecillo, Ecuador.

Type locality.— Vicinity of Lake Junin, Central Peru.

Geographic distribution.— Andean region of Ecuador and Peru.

The general color above is uniform pale chestnut brown, the front and sides of the head somewhat blackish but less dark than in *M. affinis costaricensis*, and the blackish tone is usually restricted to the head, not reaching the nape and shoulders as in *costaricensis*. The tail is black or blackish for about the terminal two inches (less in some specimens), and less intensely black than in *costaricensis*. The ventral surface and inside of limbs are pale yellowish or yellowish white, the color usually distinctly lighter than in the *M. affinis* group. In immature specimens the color of the underparts is much deeper, or pinkish buff. Usually there is more or less white on the sides of the head and between the eyes, but all traces of the facial markings so strongly developed in the *M. tropicalis* group are sometimes entirely absent. In others they strongly recall their descent from the more northern type and reveal the close relationship of the weasels of the whole Andean region with those of southern Mexico and Central America.

Mr. Heller's three specimens, all males, from Ollantaytambo (altitude 9000 feet) afford unsatisfactory data in respect to size, as two of them are young and the other, an adult, is without measurements and has no skull, this specimen having been purchased of a native.

Taczanowski's measurements of the type of his *M. jelskii* (female of *M. macrura?*) are: Total length, 323; head and body, 203; tail vertebræ, 120; hind foot, 37. A young female from Macate, Peru, are: Total length, 300; head and body, 198; tail vertebræ, 102; hind foot, 34 (M. P. Anderson).

Lönnberg (*l. c.*, p. 22) gives a few measurements of two skulls, assumed to be males, one of which is from Panecillo (near Quito, alt. 10,000 ft.), the other from Zambiza (alt. 8,000 ft.). The first is referred doubtfully to *M. macrura*, the other to *M. affinis*. They measure respectively as follows: "Condylo-incisive length of skull" (= condylobasal), 49.5 and 46 mm.; upper toothrow (with canine), 15, 13.4; width across carnassials, 17, 16. These measurements agree respectively with average male and female skulls of true *M. affinis affinis*.

Of the six specimens here referred to *M. macrura* (2 from Ecuador and 4 from Peru) five have the face markings of the *tropicalis* group vestigially represented, and in the average much more strongly than in specimens from western Colombia and Panama. The two specimens from Ambato, Ecuador, each have a large white spot in front of each ear, and a few white hairs between the eyes; the two specimens from Ollantaytambo each have a small white frontal spot, and a large white spot in front of each ear, in one forming a broad white band confluent with the white of the throat. A specimen from Mascate, Peru, a young female (No. 21147, Field Mus.) has a broad white band in front of each ear, broadly confluent with the white of the throat, and the many white hairs between the eyes form an incipient frontal band.

The first name based on the present species, *Mustela aureoventris* Gray, 1864 (not *M. aureoventris* Gray, 1865, which is composite), is preoccupied and therefore unavailable; the next in order of date is *Mustela macrura* Taczanowski, 1874, which is here adopted. His *M. jelskii* (1881) is probably only the female of his previously described *M. macrura*. The difference in size between them conforms to the usual sexual difference in the other allied South American weasels. The measurements of two specimens given by Taczanowski as " ♂ et ♀ ," in his description of *macrura* were, as his measurements show, really of the same sex and both males. The Latin diagnoses of the two species, *macrura* and *jelskii*, differ only through the addition of the word "minor" in that of *M. jelskii*, the other alleged differences in the description of *jelskii* being unimportant and negligible. It is evident that the type of *jelskii* was an old adult (sex not stated) with worn teeth, while in his specimens of *macrura* the teeth were evidently unworn.

The three specimens of weasels recorded by Lönnberg [1] from, respectively, Zambiza and Panecillo, Ecuador, are difficult to assign, if we assume the sex of the two specimens of which measurements are given is correctly determined. The measurements of the two skulls, sexed as males, differ about as the skulls of a male and a female of the same species ordinarily differ, except that those of the "interorbital width" and "postorbital constriction" are both incomprehensible, being wholly incompatible with the others, or with those of any weasel skulls known to me, both being one fourth to one third too large for his "condylo-incisive length" measurement. As above implied, I should construe the two skulls as respectively male and female of one and the same species — probably of *Mustela macrura* Taczanowski.

The *Mustela aureoventris* of Gray, as first described,[2] was based on a specimen from Quito, "about the size of the European weasel (*Mustela vulgaris*)," the head and body being given as 6 inches long and the tail 4½ inches. The sex was not stated and nothing was said about the age of the specimen, which he then evidently considered adult. A year later [1] he redescribed the species, the second description being much fuller than the first and essentially different, the length of head and body being here given as 12 inches and of the tail as 8, or about twice greater than in the first description. He now cites two specimens, the original one from Quito and another from "New Grenada." This latter I strongly suspect became later (in 1874) the type of his *Mustela affinis*,[2] judging both by the description and the locality given. He here refers to the original type as "young," and again as: "The young from Quito is much darker than the adult." Evidently two very distinct species are confounded in the second account of his *Mustela aureoventris*, so it is perhaps fortunate that the name is practically preoccupied for a Himalayan weasel by Hodgson's *Mustela auriventris*, dating from 1841.

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[1] Arkiv för Zool., VIII, No. 16, pp. 21–22, July 12, 1913.

[2] Proc. Zool. Soc. London, 1864, p. 55, pl. viii.

Mustela agilis *Tschudi.*

Mustela agilis Tschudi, Fauna Peruana, Mamm., 1844, p. 110.— Taczanowski, Proc. Zool. Soc. London, 1881, p. 648 (in text).

Type locality.— High Cordilleras of Peru.

Geographical distribution.— Known only from high altitudes in Peru.

Apparently known only from Tschudi's description, which is in substance as follows:

> Head, back and tail reddish gray; base of the hairs gray, with a broad yellowish brown ring and reddish brown tips; nose uniform deep brown, in others upper lip edged with white; throat, breast, belly and inner-upper side of extremities whitish gray, sometimes wholly gray, the base of the hairs always gray; feet darker than the body, nearly chestnut brown. Tail darker at the tip than at the base. Ears externally dark brown, whitish internally. These little animals vary nearly as much as the European weasel. Total length, 9 to 10 inches (230–250 mm.), tail 4 to 4½ (100–115 mm.), head, 1$\frac{5}{12}$ (35 mm.). (From Tschudi.)

The above description is too vague for satisfactory identification, under present conditions of available material and knowledge of the weasels of Peru. It is probable that two quite similar species of weasel, differing mainly in size, occur in the Peruvian Andes, in which case Tschudi's *Mustela agilis* may be available for one of them.

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[1] Proc. Zool. Soc. London, 1865, p. 115.

[2] Already discussed at length (*supra*, pp. 98–99).

Mustela stolzmanni *Taczanowski.*

Mustela stolzmanni Taczanowski, Proc. Zool. Soc. London, 1881, p. 835 (April, 1882).

Type locality.— Yurimaguas, eastern Peru. Altitude, 500 feet.

Geographic distribution.— Apparently known only from the type locality.

Size large, about as in *M. frenata;* soles of all the feet naked; upperparts uniform dark chestnut, the muzzle and extreme tip of the tail darker; inside of limbs and ventral surface yellowish ochre, with a broad median band of the color of the back extending from the lower part of the breast to between the mammæ; sides of upper lip broadly edged with white. Total length (♀), 503 mm.; head and body, 313; tail vertebræ, 190; hind foot (c. u.), 54. Lives in the forests of the great plain of Maynas. (From Taczanowski.)

Mustela paraensis (*Goeldi*).

Putorius (*Mustela*) *brasiliensis paraensis* Goeldi, Zool. Jahrb., X, Heft 4, pp. 556–568, pl. xxi, Sept., 1897; Bol. do Mus. Paraense, III, No. 2, pp. 195–203, August, 1901 (translation of the foregoing).

Putorius paraensis Goeldi, Bol. do Mus. Goeldi, IV, No. 1, pp. 61–62, pl. i (animal), pll. ii (skulls), Feb., 1904.

Type locality.— Pará, Brazil.

Geographic distribution.— Known only from the vicinity of Pará.

Size and proportions of *M. stolzmanni* and with the same pattern of coloration, but upperparts less dark (yellowish brown) and underparts deep ochre yellow.

The American Museum has recently received a topotype of this species from the Goeldi Museum, through the kindness of the Director, Dr. Snethlage.

Doubtless weasels of this strongly marked type will be found at intermediate points between the mouth of the Amazon and its headwaters.

Tables of Measurements.

Measurements are given in the following Tables of the specimens, both skins and skulls, in all cases where measurements are available. The field measurements doubtless are not all strictly comparable, they having been made by different collectors and by different methods, and in some cases evidently without due regard for accuracy, but it seems desirable to present them for whatever they may be worth. In the case of skulls, specimens with immature dentition have been excluded, and only 'adults' utilized; but there is a large amount of variation due solely to age, as can be seen by comparison of 'young adults' with 'old adults,' or even mature adults with very old adults.

Borrowed material is distinguished by letters following the catalogue numbers, as follows:

B = Biological Survey Collection.
F = Field Museum of Natural History.
U = United States National Museum.
Z = Museum of Comparative Zoölogy.

Table I.— Field Measurements.

Cat. No.	*Mustela tropicalis tropicalis* Locality	Sex and age	Total length	Head and body	Tail vert.	Hind foot
[1] 54994B	Jico, Vera Cruz, Mexico	♂	444	269	175	50
12794	Trujillo, “ “	♂	442	282	160	47
[2] 100041B	Teapa, Tebasco, “	♂	473	289	184	51
65422B	Catemaco, Vera Cruz, “	♀	332	211	121	37
54993B	Jico, “ “	♀	333	212	121	37
	Average, 3 males		453	280	173	49
	“ 2 females		332	212	121	37
	Mustela tropicalis nicaraguæ					
30754	Matagalpa, Nicaragua	♂	460	260	180	50
29280	“ “	♂	440	260	180	47
28969	“ “	♂	480	290	190	50
28332	“ “	♂	420	270	150	50
28592	“ “	♀	360	220	140	40
	Average, 4 males		450	275	175	49
	Minimum, “ “		420	260	150	47
	Maximum, “ “		480	290	190	50

[1] Type of *Putorius tropicalis* Merriam.
[2] Type of *Putorius tropicalis perdus* Merriam.

Table II.— Field Measurements.

Cat. No.	*Mustela affinis affinis.* Locality	Sex	Total length	Head and body	Tail vert.
24309	Sierra de Merida, Venezuela	♂	460	280	180
24307	“ “ “	♂	360	230	130
33152	“ “ “	♂	400	260	140
33154	“ “ “	♂	440	260	160
33155	“ “ “	♂	410	260	150
18205F	“ “ “	♂	420	260	160
123341U	“ “ “	♂	450	280	170
21341	“ “ “	♀	370	250	120
21342	“ “ “	♀	380	260	120
21343	“ “ “	♀	370	240	130
24311	“ “ “	♀	360	230	130
33152	“ “ “	♀	340	220	120
	Average, 7 males		420	261	156
	Minimum, “ “		360	220	130
	Maximum, “ “		470	260	180
	Average, 5 females		364	240	124
	Minimum, “ “		340	220	120
	Maximum, “ “		380	260	130

Table III.— Field Measurements.

Cat. No.	*Mustela affinis costaricensis.* Locality.	Sex and age	Total length	Head and body	Tail vert.	Hind foot
10112Z	Boquete, Chiriqui, Panama	♂ old	480	310	170	52
10113Z	“ “ “	♂ juv.	400	257	143	43
137514U	“ “ “	♂ old	460	280	180	50
178970B	Mt. Pirri, Panama	♂ juv.	422	258	164	50
170970B	Rio Indio (Gatun), Panama	♀ old	408	249	159	46
	Average, 4 males (mostly young ad.)		440	276	164	49
	Minimum, “ “		400	257	143	43
	Maximum, “ “		480	310	180	52
34677	Gualea, Ecuador	♂ old	470	310	160	50
32620	Munchique, Cauca, Colombia	♂ old	495	293	202	52
37679	Sta. Elena, Antioquia, “	♂ ad.	425	253	168	48
37678	“ “ “	♂ ad.	420	255	165	50
37680	Barro Blanco, “ “	♂ ad.	412	252	160	47
32182	Miraflores, Cauca “	♀ ad.	375	225	150	43
	Average, 5 males		444	273	151	50
	Minimum, “ “		412	252	160	47
	Maximum, “ “		495	310	202	52

Table IV.— Measurements of Skulls of Mustela tropicalis tropicalis, M. t. nicaraguæ, and M. paraensis.

Cat. No.	*Mustela tropicalis tropicalis* Locality	Sex	Total length	Condylobasal length	Zygomatic breadth	Interorbital breadth	Postorbital processes	Postorbital breadth	Breadth of braincase	Mastoid breadth	Upper toothrow	Maxillary toothrow	M¹	Age
[1] 54994B	Jico, Vera Cruz, Mex.	♂	51.5	52.1	28.4	10.8	15.2	12.5	23.1	25.2	15.1	11.8	5.7	old
132528B	Perez, “ “ “	♂	48.4	49	27	10.4	13.8	9.6	21.6	23.5	13.7	10.8	56	old
11058	Trujillo, “ “ “	♂	51.5	50.5	30.4	11.5	14.3	12.1	23.8	24.4	14.5	12.2	5.9	old
[2] 100041B	Teapa, Tebasco, Mex.	♂	52.4	51.5	28.9	11.5	13.8	10.6	22.9	24.7	15	12.2	6	old
65422B	Cotemaco, Vera Cruz, Mex.	♀	44.8	44.6	23.7	9.3	11.2	10	21.6	21.4	12.4	10	5.5	old
54993B	Jico, “ “ “	♀	41.5	40.7	23.1	9.6	12.2	9.5	20.3	20.3	11.6	10	4.7	old
38290U	Guatemala	♀	—	—	—	10.5	13.5	11	—	—	13.1	10.9	5.2	old
61277U	“ (San Geronimo)	♀	—	—	—	9.1	11.5	11.1	21.4	20.9	12.4	10	5	old
	Average, 4 males		50.9	50.8	28.7	11.1	14.3	11.2	22.8	24.5	14.6	11.7	5.8	
	Minimum, “ “		48.4	49	27	10.4	13.8	9.6	21.6	23.5	13.7	10.8	5.6	
	Maximum, “ “		52.4	52.1	30.4	11.5	15.2	12.5	23.8	25.2	15.1	12.2	6	
	Mustela tropicalis nicaraguæ													
29280	Matagalpa, Nicaragua	♂ad.	50.7	50.6	27.5	11.2	14.8	12.9	22.1	23.6	14.5	12.2	6.2	od
30754	“ “	♂ad.	49.7	50	—	10.5	13.4	10.4	22.6	23.6	15	12.5	6.4	old
28322	“ “	♂ad.	—	—	—	10.8	15.3	11.6	—	—	14.9	12	5.8	juv.
	Average		50.2	50.6	27.5	10.8	14.5	11.6	22.4	23.6	14.8	12.2	6.1	
	Mustela paraensis													
37415	Pará, Brazil	♂ad.	53.6	53.7	32.5	13	15.5	10.7	25.1	27.1	15	11.7	6.1	old

Table V.— Measurements of Skulls of *Mustela affinis costaricensis.*

Cat. No.	*Mustela affinis costaricensis* Locality	Sex	Total length	Condylobasal length	Zygomatic breadth	Interorbital breadth	Postorbital processes	Postorbital breadth	Breadth of braincase	Mastoid breadth	Upper toothrow	Maxillary toothrow	M^1	Age
38288U	Costa Rica	♂	—	—	30.4	12.3	14.9	11.5	24.6	27.1	14.8	11.8	6.1	juv.
[1] 37149U	“ “ (San José)	♂	51.9	53.5	29	11.9	15.5	14.1	24.3	25	15.7	12.7	5.6	old
38287U	“ “	♂	49.6	50.9	27.4	11.4	14.4	12	23	24.3	14.5	11.6	5.8	juv.
172960U	Boquete, Chiriqui	♂	47.6	—	27	11.1	14.3	13	24.1	23.3	14.1	11.8	5.5	juv.
137514U	“ “	♂	49.7	47.6	25.5	10.9	14	13.3	22.7	22.1	13.8	11.4	5.5	juv.
18848	“ “	♂	49.6	49.4	29.8	11.7	14.9	11.9	22.3	22.7	14.4	12	5.6	old
101123U	“ “	♂	53.6	53.7	—	12.7	15.9	11.7	22.8	25.7	15.3	12.7	5.5	very old
101133U	“ “	♂	48.5	47.8	27.3	12.3	15	12.4	—	—	13.6	11	5.6	juv.
178970B	Panama (Mt. Pirri)	♂	49.4	49.5	26.8	10.6	13.7	12.1	22.1	22.6	14.7	11.7	5.5	juv.
170970B	“ (Rio Indio)	♀?	47.8	47.1	27.2	10.5	13.6	10.7	22.7	23.2	13	11.1	5.3	old
	Average, 9 males		50	50.3	27.9	11.8	14.7	12.4	23.2	24	14.5	11.9	5.6	
	Minimum, “ “		47.6	47.6	25.5	10.6	13.7	11.9	22.1	22.1	13.6	11	5.5	
	Maximum, “ “		53.6	53.7	29.8	12.7	15.9	14.1	24.6	27.1	15.7	12.7	6.1	
34677	Gualea, Ecuador	♂	50.5	50.8	28.5	12.2	15.2	12	22.1	24.2	15.4	12.5	6.2	old
32620	Munchique, Cauca, Col.	♂	52.2	52.1	30.3	12.7	16.6	12.9	22.5	24.1	14.9	12.4	6.1	old
37678	Sta. Elena, Antioquia, Col.	♂	49.6	47.8	27.3	12	15.1	13	23.1	23.5	14.2	12.	5.6	old
37679	“ “ “ “	♂	48	47.9	26.3	11.8	15.6	12.6	21.5	22.6	14	11.1	5.7	old
37680	Barro Blanco, “ “	♂	—	—	27.6	12.2	15	12.1	—	—	14.5	11.6	6.1	old
32182	Mira Flores, Cauca, Col.	♀	45	44.8	24.2	10.1	12.7	10.2	21	21	13.1	10.8	5.6	old
14462	Rio Zapata, “ “	♀	42.8	42.1	—	9.4	12.6	—	19.4	—	12.1	10.4	5	old
14463	“ “ “ “	♀	—	—	—	10.2	—	—	—	—	12.1	10	5.2	old
	Average of 5 males		50.1	49.6	28	12.2	15.5	12.5	22.6	23.6	14.6	11.9	5.9	
	Minimum of “ “		48	47.8	26.3	11.8	15	12	21.5	21.6	14	11	1.6	
	Maximum of “ “		52.2	52.1	30.3	12.7	16.6	12.7	23.1	24.2	15.4	12.5	6.2	

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[1] Type of *M. a. costaricensis.*

Table VI.— Measurements of Twelve Skulls of Mustela affinis affinis.

Cat. No.	Locality	Sex	Total length	Condylo-basal length	Zygomatic breadth	Interorbital breadth	Postorbital processes	Postorbital breadth	Breadth of braincase	Mastoid breadth	Upper toothrow	Maxillary toothrow	M¹	Age
[1]123341U	Sierra de Merida, Venezuela	♂	48.6	47.9	26.9	12.2	—	—	23.1	—	14.8	—	—	old
24307	" " " "	♂	47	46	25.5	—	—	—	23.4	23.7	14.2	11.6	6	juv.
24309	" " " "	♂	49.4	49	27.6	11.9	15.2	11.5	22	24.1	13.8	11.6	5.6	old
33154	" " " "	♂	46.7	46.8	26.6	10.6	14.6	12.4	23.6	22.3	13.3	10.9	5.4	juv.
33152	" " " "	♂	48.8	48.9	29	12.2	15.7	10.6	22.1	24.1	14.1	11.4	5.7	old
33155	" " " "	♂	48	—	27.4	11.7	16.2	13.5	22.5	23.6	14.6	11.5	5.7	old
33153	" " " "	♀	40.6	40.8	22.9	9.7	12.4	11.4	21.6	19.5	11.5	9.7	4.9	old
24308	" " " "	♀	41.6	40.7	22.5	9.8	12.5	10.4	20	19.5	11.8	9.5	5.2	old
21343	" " " "	♀	41.7	41.8	22.8	9.5	12.1	10.4	21	19.4	11.9	10.4	5.2	old
24311	" " " "	♀	43.1	42.7	22	10.1	12.8	10.5	19.4	19.8	12.2	10	5.2	old
24310	" " " "	♀	40.4	39.4	22.3	8.8	11.2	10.8	21	19.6	11.4	9.4	4.9	juv.
———	" " " "	♀	40.7	—	23.3	—	—	—	—	—	12	—	—	old
	Average, 6 males		48	47.7	27.2	11.6	15.4	12	22.9	23.6	14	11.4	5.7	
	Minimum, " "		46.7	46.8	25.5	10.6	14.6	10.6	22	22.3	13.3	10.9	5.4	
	Maximum " "		49.4	49	29	12.2	16.2	13.5	23.6	24.1	14.6	11.6	6	
	Average, 6 females		41.5	41.1	22.6	9.6	12.2	10.7	20.6	19.6	11.8	9.8	5.1	
	Minimum, " "		40.4	39.4	22	8.8	11.2	10.4	19.4	19.4	11.5	9.4	4.9	
	Maximum " "		43.1	42.7	23.3	10.1	12.8	11.4	21.6	19.8	12.2	10.4	5.2	
	Paramo de Tama, Colombia	♂	47.3	48	27.1	11.3	14.6	12.6	22.1	22.6	14.6	11.9	6 5	old
	" " " Venezuela	♂	—	—	23	9.5	12.4	11.8	19.6	—	12.7	9.4	5	old
	Paramo de Choachi, near Bogotá, Col.	♂	46.2	46.5	26.3	11.1	14.5	12.5	23.8	22.9	13.8	11.6	5.3	old
	San Esteban, Venezuela	♂	49.6	49.8	28.5	11.8	11.7	11.7	22.6	24.6	14.6	11.6	5.8	very old

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[1] Type of *Mustela meridana* Hollister.

Table VII.—Summary of Tables I to VI.

External Measurements — Averages.

MALES.	Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot
Mustela tropicalis tropicalis	3	453	280	173	49.3
“ “ *nicaraguæ*	4	450	275	175	49
“ *affinis affinis* (Merida)	7	420	261	156	—
“ “ *costaricensis* (Panama)	4	440	276	164	49
“ “ “ (Colombia)	5	444	273	151	50
FEMALES.					
Mustela tropicalis tropicalis	1	333	212	121	37
“ “ *nicaraguæ*	1	360	220	140	40
“ *affinis affinis* (Merida)	5	364	240	124	—
“ “ *costaricensis* (Colombia)	1	375	225	150	53
“ “ *macrura* (Peru)	2	311	201	126	40

Cranial Measurements — Averages.

MALES.	Number of specimens	Total length	Condylobasal length	Zygomatic breadth	Postorbital processes	Breadth of braincase	Mastoid breadth	Upper toothrow	Maxillary toothrow
Mustela tropicalis tropicalis	4	50.9	50.8	28.7	14.3	22.8	24.5	14.6	11.7
“ “ *nicaraguæ*	3	50.2	50.6	27.5	14.5	22.4	23.6	14.8	12.2
“ *affinis affinis* (Merida)	6	48	47.7	27.2	15.4	22.9	23.6	14	11.4
“ “ “ (elsewhere)	4	47.7	48.1	26.2	13.3	18	23.1	13.9	11.1
“ “ *costaricensis* (Costa Rica, Panama)	9	50	50.3	27.9	14.7	23.2	24	14.5	11.9
“ “ “ (Colombia)	5	50.1	49.6	28	15.5	22.6	23.6	14.6	11.9
“ *paraensis*	1	53.6	53.7	32.5	15.5	25.1	27.1	15	11.7
FEMALES.									
Mustela tropicalis tropicalis	2	43.2	42.4	23.4	12.1	21.1	20.9	12.4	10.2
“ *affinis affinis* (Merida)	6	41.5	41.1	22.5	12.2	20.6	19.6	11.8	9.8
“ “ *costaricensis* (Colombia)	3	43.9	43.4	—	13.4	20.2	—	12.6	10.4

59.9(86.6)

Article XIII.— LIST OF MAMMALS COLLECTED FOR THE AMERICAN MUSEUM IN ECUADOR BY WILLIAM B. RICHARDSON, 1912–1913.

By J. A. Allen.

While collecting birds for the American Museum of Natural History in Ecuador, Mr. Richardson, under the direction of Dr. Frank M. Chapman, Curator of Ornithology, made also a considerable collection of mammals, which adds somewhat to the knowledge of the mammal fauna of that country. In working up the collection, in connection with other recent accessions of mammals from South America, the forms that seemed to be new I have already described in a series of separate papers. The present paper is therefore a summary list of the specimens, with the field data and such technical comment as seemed pertinent.

The total number of specimens obtained by Mr. Richardson in Ecuador is about 240, representing 70 species and subspecies, of which 21 have been described as new in former volumes of this Bulletin, as cited below in the 'Systematic List.' Following is a list of the new forms, with their type localities and the dates of publication:

1. *Tamandua tetradactyla punensis*, Puna Island, April 28, 1916.
2. *Pecari niger*, Manavi, Sept. 25, 1913.
3. *Mazama fuscata*, Rio de Oro, Nov. 2, 1915.
4. *Mazama gualea*, Gualea, Nov. 2, 1915.
5. *Mazama zamora*, Zamora, Nov. 2, 1915.
6. *Lepus daulensis*, Daule, Feb. 28, 1914.
7. *Dasyprocta variegata zamoræ*, Zamora, Dec. 30, 1915.
8. *Coendu quichua richardsoni*, Esmeraldas, Sept. 25, 1913.
9. *Melanomys caliginosus oroensis*, Rio de Oro, Manavi Province, Nov. 17, 1913.
10. *Thomasomys aureus altorum*, Mt. Pichincha, Feb. 28, 1914.
11. *Sigmodon chonensis*, Chone, Sept. 25, 1913.
12. *Sciurus hoffmanni manavi*, Manavi, Oct. 8, 1914.
13. *Sciurus igniventris zamoræ*, Zamora, Oct. 8, 1914.
14. *Sciurus stramineus zarumæ*, Zaruma, Oct. 8, 1914.
15. *Tayra barbara senilis*, Manavi, Sept. 25, 1913.
16. *Procyon æquatorialis*, Manavi Province, Dec. 30, 1915.
17. *Dasypterus ega punensis*, Puna Island, July 9, 1914.
18. *Myotis punensis*, Puna Island, July 9, 1914.
19. *Myotis esmeraldæ*, Esmeraldas, July 9, 1914.
20. *Nyctinomus æquatorialis*, Chone, July 9, 1914.
21. *Cebus æquatorialis*, Manavi, Dec. 14, 1914.

Mr. Richardson began work in Ecuador at Esmeraldas in October, 1912, passing slowly down the coast with side trips into the interior at various points, completing his reconnoissance of the country in December, 1913. The principal localities at which mammals were collected are as follows:

Esmeraldas, Oct. 23–Dec. 6. Near sea-level. 47 specimens.
Chone, Manavi, Dec. 16–29. Near sea-level. 11 specimens.
Rio de Oro, Manavi, Jan. 7–28. Alt. 1500 ft. 13 specimens.
Manavi, Manavi, January. Sea-level. 20 specimens.
Guayaquil, Guayas, March 16–26. Near sea-level. 4 specimens.
Isla de Puna, Guayas, April 7–12. 14 specimens.
Daule, Guayas, April 21–27. Alt. 2000 ft., 16 specimens.
Naranjo, Guayas, May 8–11, Dec. 21–28. Alt. 2000 ft. 9 specimens.
Gualea, Pichincha, May 18–June 20. Alt. 6000–9000 ft. 18 specimens.
Quito and **Mt. Pichincha,** May 15–June 13. 22 specimens (part purchased of native collectors).
Baeza (eastern slope). Alt. 3000 ft. 5 specimens, probably purchased at Quito.
Antisana, Pichincha, June 12–13. Alt. 12,000 ft. 4 specimens.
Mt. Chimborazo, July 1–5. 8 specimens.
El Lorazon and **Valle de Cumbra,** July 16–29. 6 specimens.
Zaruma, Azuay, Sept. Alt. 4000–6000 ft. 10 specimens.
Zamora, Loja, Oct. 20–Nov. 3. Alt. 2000 ft. 27 specimens.
Loja and **Sta. Rosa, Loja,** Nov. 11–Dec. 2. Alt. 8000 ft. 7 specimens.

As shown by the above, Mr. Richardson's mammal collecting was very superficial, only a few specimens having been taken at any single locality. This evidently could hardly have been otherwise in view of the great extent of country covered during about fourteen months, and of the further fact that his mammal collecting was incidental to his special work of obtaining birds. The relatively large number of new forms contained in this small collection of mammals indicates how little is yet known of the mammal fauna of Ecuador, where as yet no thoroughly systematic collecting has been undertaken.

Several papers have been published on the mammals of Ecuador, but in general the literature relating to them consists of incidental references in more general works and descriptions of new species based on Ecuador specimens. The principal special papers are the following:

1. Tomes, Robert F. Notes on a Collection of Mammalia made by Mr. [Louis] Fraser at Gualaquiza. *Proc. Zool. Soc. of London,* 1858, pp. 546–549.

Seventeen species are recorded but 3 of them are not identified. The number of specimens is not stated. They include 8 species of bats, 7 species of rodents (including "*Echimys cayenensis*"), and 2 species of small marsupials.

2. Tomes, Robert F. Notes on a Second Collection of Mammalia made by Mr. [Louis] Fraser in the Republic of Ecuador. *Proc. Zool. Soc. London,* 1860, pp. 211–221.

Fifteen species, 4 described as new. "The greater portion of these are believed to have been taken at Pallatanga, on the western slope of the Cordillera; but the exact locality is not certain, from the specimens having been unfortunately mixed together." The number of specimens was not stated, but was probably between 30 and 40. The following are described as new: *Hesperomys latimanus* (p. 213), *H. minutus* (p. 215), *H. bicolor* (p. 217 = *H. longicaudatus* of Tomes's previous list), *H. aureus* (p. 219).

3. Tomes, Robert F. Notes on a Third Collection of Mammalia made by Mr. [Louis] Fraser in the Republic of Ecuador. *Proc. Zool. Soc. of London*, 1860, pp. 260–268.

Twenty-one species, 3 of them described as new, as follows: *Hesperomys caliginosus* (p. 263, = *Akodon caliginosus* of most subsequent authors prior to 1913), *H. albigularis* (p. 264), *Echimys semispinosus* (p. 265, = *E. cayenensis* of Tomes's first paper).

4. Thomas, Oldfield. On Mammals from Ecuador. *Proc. Zool. Soc. London*, 1880, pp. 393–403, text figs. 1–3, pl. xxxviii.

Forty-one species, 141 specimens, collected mainly by Clarence Buckley, partly near Quito but mainly south and southeast of Riobamba, on the upper tributaries of the Rio Pastaza. A remarkable feature of the collection is the large number of monkeys it contained — 60 specimens, representing 10 species, all but one of which (from Intac, 50 miles north of Quito) were from the Rio Copataza, a tributary of the upper Rio Pastaza, at a point "about 50 miles southeast of Sarayacu." At the Sarayacu here mentioned (not the better known Sarayacu on the Rio Ucayale in Peru), on the Rio Bobonasa, a tributary of the upper Rio Pastaza, was made the greater part of the remainder of the collection, numbering 57 specimens, representing 27 species. These include 5 species of bats, 6 species of carnivores, a tapir, 2 species of deer, 8 species of edentates, and 2 species of marsupials. The single new species is *Bassaricyon alleni* (pp. 397–400, text figs. 1–3, and pl. xxxviii (colored)). It thus appears that the bulk of the collection (117 specimens, representing 37 of the 41 recorded species) came from two neighboring points (Sarayacu and Rio Copataza) in the Amazonian drainage of the Oriente, while the greater part of the Fraser Collections came mainly from the western slope of the Cordillera at rather high altitudes, and consisted chiefly of bats and rodents, as did also the 12 specimens here recorded by Thomas from Balzar, collected by Mr. Illingworth.

5. Lönnberg, Einar. Mammals from Ecuador and related forms. *Arkiv för Zoologi*, VIII, No. 16, pp. 1–36, text fig. 1 (feet of *Tayra*), pl. i, colored (*Felis pajeros thomasi* sp. nov. (animal)). July 12, 1913.

Thirty-six species are recorded from Ecuador; the number of specimens is not stated. Based on a collection presented to the Natural History Museum of Stockholm by L. Söderström, for many years Swedish Consul in Quito, well known as a collector of birds and mammals in the Quito region. Most of the specimens are from the slopes of Mt. Pichincha, with a few from Gualea, Zambiza, and the vicinity of Chone in the coast region. Some twelve pages are given to a review of the genus *Tayra*, of which two forms are described as new — *Tayra barbara tucumana* (p. 14), from Tucuman, Argentina, and *T. b. madeirensis* (p. 19), from "Humaythan River, Madeira, Amazona." The following new forms are based on Ecuador specimens: *Felis concolor söderströmii* (p. 2), from Mono, northwestern slope of Mt. Pichincha; *Felis pajeros thomasi* (p. 7), Quito; *Nasua olivacea quitensis* (p. 23), Lloa, Mt. Pichincha; *Agouti sierræ andina* (p. 28), Mt. Pichincha, 9,000 to 12,000 feet; *Dasypus novemcinctus æquatorialis* (p. 34), Peruchu, 7,000–9,000 feet.

6. Stone, Witmer. On a Collection of Mammals from Ecuador. *Proc. Acad. Nat. Sci. Philadelphia*, 1914, pp. 9–19. March 31, 1914.

Based on a collection of 66 specimens made by Samuel N. Rhoads, collected February to July, 1911, representing 19 species (including 3 introduced rats), the following described as new: *Thomasomys rhoadsi* (p. 12), paramo of Mt. Pichincha; *Sciurus hoffmanni söderströmi* (p. 14), Mt. Pichincha, collected by Söderström; *Blarina osgoodi* (p. 16), Mt. Pichincha, 10,500–12,000 feet. Besides the field notes of the collector, Dr. Stone has greatly increased the value of the paper by technical comment on various species and the addition in many cases of the collector's measurements and field notes.

Although many collectors have visited Ecuador and have sent many mammals as well as birds to various European Museums since the days of Fraser and Buckley, little faunistic work based on their collections has been made public, although many new forms have been published based on these sources. Söderström, as is well known, has made extensive collections in the Quito region which have been sent to the museums of Warsaw, Stockholm, and London, and while they have furnished many new species, described by Taczanowski, Thomas, Lönnberg and others, no formal reports, with field data and measurements, have been based on this important mammal material, thus of value only to those who have personal access to it. The same is unfortunately true of the large collection of mammals made in southern Ecuador by Perry O. Simons in 1898–1899.

Systematic List.

DIDELPHIIDÆ.

1. **Didelphis marsupialis etensis** *Allen.*

Nine specimens: Esmeraldas, 5; Puna Island, 2; Daule, 1; Zaruma, 1.

2. **Didelphis paraguayensis andina** *Allen.*

Three specimens: Quito, 2; El Lorazon, 1.

3. **Metachirus opossum melanurus** *Thomas.*

Two specimens: Esmeraldas, 1; Rio de Oro, 1.

BRADYPODIDÆ.

4. **Bradypus ephippiger** *Philippi.*

One specimen, Rio de Oro.

MYRMECOPHAGIDÆ.

5. **Myrmecophaga tridactyla** *Linné.*

One specimen, Baeza, east of the Andes.

6. **Tamandua tetradactyla punensis** *Allen.*

Three specimens: Puna Island (type); Guayaquil, 2. (This Bull., Vol. XXXV, p. 83, 1916).

7. **Cyclopes didactylus ida** *Thomas.*

One specimen, Manavi.

TAYASSUIDÆ.

8. **Pecari niger** (*Allen*).

Two specimens, Esmeraldas. (Bull. XXXII, p. 476, 1913).

CERVIDÆ.

9. **Mazama fuscata** *Allen.*

Two specimens, an old male and a young female, Rio de Oro. (Bull. XXXIV, p. 545, 1915.)

10. **Mazama gualea** *Allen.*

Two specimens, Gualea. (Bull. XXXIV, p. 545, 1915).

11. **Mazama zamora** *Allen.*

One specimen, Zamora. (Bull. XXXIV, p. 546, 1915.)

12. **Mazama rufina** (*Pucheran*).

One specimen, Mt. Pichincha, practically a topotype. (Bull. XXXV, p. 540, 1915.)

LEPORIDÆ.

13. **Lepus andinus** *Thomas.*

Four specimens, two from Quito and two from Mt. Pichincha. May and June.

14. **Lepus daulensis** *Allen.*

One specimen, Daulea. (Bull. XXXIII, p. 199, 1914.)

OCTODONTIDÆ.

15. **Proechimys semispinosus calidior** *Thomas.*

Esmeraldas, 2 adult and 1 young.

DASYPROCTIDÆ.

16. **Dasyprocta variegata zamoræ** *Allen.*

Four specimens, Zamora and Naranjo. (Bull. XXXIV, p. 627, 1915.)

ERETHIZONTIDÆ.

17. **Coendu quichua richardsoni** *Allen.*

One specimen, Esmeraldas. (Bull. XXXII, p. 478, 1913.)

MURIDÆ.

18. **Epimys rattus rattus** (*Linné*).

One specimen, Naranjo. Typical.

19. **Epimys rattus alexandrinus** (*Geoffroy*).

Two specimens, 1 each from Esmeraldas and Daule. Very light-colored above and clear white below.

20. **Oryzomys aureus** (*Tomes*).

Six specimens, Esmeraldas.

21. **Oryzomys auriventer** *Thomas.*

Four specimens, Zamora.

22. **Oryzomys longicaudatus** (*Bennett*).

One specimen, immature male, Gualea, altitude 6000 feet.

23. **Oryzomys dryas** *Thomas.*

Two specimens, Zamora.

24. **Oryzomys nitidus** (*Thomas*).

Thirteen specimens: Gualea, 1; Zamora, 12.

25. **Oryzomys (Oligoryzomys) stolzmanni** *Thomas.*

Seven specimens: Gualea, 6; Valle de Cumbra, 1.

26. **Melanomys caliginosus caliginosus** (*Tomes*).

Eight specimens; Esmeraldas, 7; Chone, 1. (Bull. XXXII, p. 537, 1913.)

27. **Melanomys caliginosus oroensis** *Allen.*

Three specimens, Rio de Oro. (Bull. XXXII, p. 538, 1913.)

28. **Melanomys phæopus phæopus** (*Tomes*).

Two specimens, Gualea. (Bull. XXXII, p. 541, 1913.)

29. **Melanomys phæopus olivinus** (*Thomas*).

One specimen, Rio de Oro. (Bull. XXXII, p. 543, 1913.)

30. **Œcomys bicolor** (*Tomes*).

Two specimens, both young, Mt. Pichincha.

31. **Thomasomys aureus aureus** (*Tomes*).

One specimen, Gualea.

32. **Thomasomys aureus altorum** *Allen.*

Two specimens, Mt. Pichincha, alt. 11,000 ft. (Bull. XXXIII, p. 200, 1914.)

33. **Thomasomys paramorum** *Thomas.*

Seven specimens, Mount Chimborazo, altitude 14,000–15,000 ft. These specimens, all males, are shown by the skulls to be fully adult.

The collector's measurements give, total length, 222 (210–235); head and body, 93.6 (85–100); tail, 128.6 (125–135); hind foot, 25.

The type locality is given as "Paramo, south of Chimborazo." The type was a spirit specimen, in which the color of the upperparts had doubtless been changed by the preservative from fulvous brown to "rufous brown." Otherwise the present specimens, practically topotypes of the species, agree with the description of *paramorum*.

34. **Akodon mollis altorum** *Thomas.*

Two specimens, Mt. Chimborazo, altitude 14,000 feet.

35. **Phyllotis haggardi** *Thomas.*

Four specimens, Antisana, altitude, 12,000 feet.

36. **Sigmodon chonensis** *Allen.*

Eleven specimens, Chone and Rio de Oro. (Bull. XXXII, p. 479, 1913.)

SCIURIDÆ.

37. **Mesosciurus hoffmanni hoffmanni** (*Peters*).

Fourteen specimens: Gualea, 5; Zaruma, 4; Santa Rosa, 3; Loja, 2. (Bull. XXXIV, p. 217, 1915.)

38. **Mesosciurus hoffmanni manavi** (*Allen*).

Twelve specimens: Manavi, 5; Esmeraldas, 3; Naranjo, 4. (Bull. XXXIII, p. 589, 1914; XXXIV, p. 221, 1915.)

39. **Mesosciurus gerrardi versicolor** (*Thomas*).

Two specimens, Esmeraldas. (Bull. XXXIV, p. 242, 1915.)

40. **Urosciurus igniventris zamoræ** (*Allen*).

One specimen, Zamora. (Bull. XXXIII, p. 594, 1914; XXXIV, p. 274, 1915.)

41. **Simosciurus stramineus zarumæ** (*Allen*).

One specimen, Zaruma. (Bull. XXXIII, p. 597, 1914; XXXIV, p. 284, 1915.)

MUSTELIDÆ.

42. **Lutra** sp.

A hunter's pelt, without skull, Esmeraldas.

43. **Tayra barbara senilis** (*Allen*).

Tayrara barbara irara LONNBERG (not of Allen), Ark. för Zool., VIII, No. 16, p. 13, July 12, 1913. Camino de Chone, Manavi Province, Ecuador.

Two specimens, Manavi. (Bull. XXXII, p. 484, 1913).

A second specimen from Naranjo, Dec. 25, 1913, also is an old female, like the type, which it resembles in every way except that it is in fresher pelage and the colors are of a deeper tone, the nape being distinctly pale golden and the large throat patch deep yellow.

Collector's measurements of the second specimen, total length, 1040; head and body, 630; tail vertebræ, 410; hind foot, 100. Skull, total length, 124; condylobasal length, 118; zygomatic breadth, 65; interorbital breadth, 24; postorbital breadth, 23.3; breadth of braincase, 46; mastoid breadth, 52; length of maxillary toothrow, outer border, 24.5.

44. **Conepatus quitensis** (*Humboldt*).

Five specimens, 3 adult, 2 young, Mt. Pichincha, near Quito.

No external measurements. The skulls of an old adult male and an old adult female, both with the sagittal crest strongly developed, measure as follows: Total length, ♂ 93, ♀ 86; condylobasal length, ♂ 86, ♀ 61; zygomatic breadth, ♂ 55.6, ♀ 51; mastoid breadth, ♂ 48, ♀ 44; maxillary toothrow, ♂ 19, ♀ 19.

PROCYONIDÆ.

45. **Procyon (Euprocyon) æquatorialis** *Allen.*

One specimen, Manavi. (Bull. XXXIV, p. 630, 1915.)

46. **Nasua nasua manium** *Thomas.*

Two specimens: Zaruma, 1, adult male, Oct. 2, 1913; Naranjo, 1, old male, Dec. 28, 1913.

47. **Nasua nasua quichua** *Thomas.*

Four specimens: Zamora, 3 males, one adult, one very old, and a young one in first pelage; Baeza, 1, adult male. These localities are on the eastern slope, at altitudes respectively of 2000 and 3000 feet, but the specimens agree satisfactorily with the description of *quichua,* of the central region of the Cordilleras, both in size and coloration.

It is probable that the Baeza specimen is referable to Thomas's recently described *Nasua quichua jivaro,* if separable from *quichua.*

48. **Nasua olivacea quitensis** *Lönnberg.*

One specimen (skin only), adult female, Gualea, June 1, 1913.

49. **Potos flavus modestus** *Thomas.*

Two specimens (skins only), Esmeraldas.

Canidæ.

50. **Cerdocyon thous** (subsp. indet.).

One skull (skin mislaid), Quito.

51. **Pseudalopex sechuræ** (*Thomas*).

One skin, with imperfect skull, Manta, Manavi.

This specimen closely agrees in all respects with the description of *Canis sechuræ* Thomas, from the Sechura desert of northwestern Peru.

52. **Pseudalopex culpæus reissii** (*Hilzheimer*).

Two adult males, skins and skulls, and an additional skull, Quito.

These two skins differ in coloration, one being much more strongly suffused with red and yellow than the other; in one the top of the head is grizzled pale ochraceous buff and black only as far back as the ears, while in the other the upper surface of the entire head and nape is deep ochraceous rufous; in the dark-headed one the terminal portion of the dorsal underfur is dingy pale buff, while in the other it is bright ochraceous buff. This would seem to show that the color characters alleged to distinguish *P. culpæus andina* Thomas (Ann. and Mag. Nat. Hist. (8), XIII, p. 358, March, 1914) are not wholly trustworthy. The three skulls are larger, however, than the measurements given for the type of *andina*. Their principal dimensions are as follows: Total length (No. 36454 ♂) 174, (No. 36455 ♂) 169, (No. 36455*a* ♀ ?) 160; condylobasal length, 164, 156, 152; zygomatic breadth, 94, 88, 89.5; length of nasals on midline, 62, 54, 51; palatal length, 89, 89.4, 80.5; length of p^4, 16.2, 16, 15; combined length of m^1 and m^2, 19, 16.2, 15.

FELIDÆ.

53. **Oncoides pardalis æquatorialis** (*Mearns*).

Felis æquatorialis MEARNS, Proc. U. S. Nat. Mus., XXV, No. 1286, p. 246, Sept. 17, 1903. Type locality, Paramba, northern Ecuador; altitude 3,500 ft.

One specimen, adult female, skin and skull, Daule.

The collector's measurements are, total length, 1190 mm.; tail vertebræ, 420; hind foot, 170. The skull measures, total length, 131; condylobasal length, 121.5; zygomatic breadth, 88; interorbital breadth, 23.5; postorbital breadth, 34; breadth of braincase, 51; length of nasals on midline, 27, on outer border, 33.5; length of maxillary toothrow, 31; upper carnassial, 16 × 7.8.

54. **Margay wiedi andina** (*Thomas*).

Felis pardinoides andina, Ann. and Mag. Nat. Hist. (7), XII, p. 238, Aug. 1903. Jima, Azuay, Ecuador; alt. 2400 m.

One specimen, adult female, skin only, Loja (alt. 8000 ft.). Taken not far from the type locality of *andina*. Collector's measurements: Total length, 1160 mm.; tail vertebræ, 470; hind foot, 110.

EMBALLONURIDÆ.

55. **Saccopteryx bilineata** (*Temminck*).

Two specimens, Esmeraldas.

PHYLLOSTOMIDÆ.

56. **Glossophaga soricina valens** *Miller*.

Seven specimens: Manavi, 1; Daule, 6.

57. **Hemiderma perspicillatum** (*Linné*).

Two specimens, Manavi.

58. **Sturnira lilium** (*Geoffroy*).

Two specimens, Zamora.

59. **Uroderma bilobatum** *Peters.*

Six specimens, Esmeraldas.

60. **Artibeus toltecus ravus** *Miller.*

Four specimens, Esmeraldas.

61. **Artibeus lituratus** (*Illiger*).

One specimen, Duran.

FURIPTERIDÆ.

62. **Amorphochilus schnablii schnablii** *Peters.*

Three specimens, Puna Island. (Bull. XXXIII, p. 381, 1914.)

VESPERTILIONIDÆ.

63. **Dasypterus ega punensis** *Allen.*

Five specimens, Puna Island. (Bull. XXXIII, p. 382, 1914.)

64. **Myotis punensis** *Allen.*

Three specimens: Puna Island, 2; Daule, 1. (Bull. XXXIII, p. 382, 1914.)

65. **Myotis esmeraldæ** *Allen.*

Four specimens: Esmeraldas, 2; Manavi, 1; Naranjo, 1. (Bull. XXXIII, p. 385, 1914.)

MOLOSSIDÆ.

66. **Nyctinomus æquatorialis** *Allen.*

One specimen, Chone, Manavi Province. (Bull. XXXIII, p. 386, 1914.)

67. **Promops fosteri** (*Thomas*).

Two specimens, Manavi.

68. **Molossus pygmæus** *Miller.*

Six specimens: Puna Island, 1; Daule, 5.

CEBIDÆ.

69. **Pithecia monachus** *E. Geoffroy.*

One specimen, adult male, Baeza, Ecuador, eastern slope of the Andes at 3000 feet. A skin, without skull or measurements, purchased from a native collector.

70. **Cebus æquatorialis** *Allen.*

Five specimens, Manavi. (Bull. XXXIII, p. 654, 1913.)

56.7,48(115:77.1)

Article XIV.— THE LUNGFISH REMAINS OF THE COAL MEASURES OF OHIO, WITH SPECIAL REFERENCE TO THE SUPPOSED AMPHIBIAN *EURYTHORAX* OF COPE.

By L. Hussakof.

Introduction.

In 1871 Cope described a flat plate, three inches in diameter, from the Coal Measures of Ohio, which he regarded as the interclavicle of a new genus of amphibian and named *Eurythorax sublævis*. The description consisted of only two lines, which read: "The pectoral median shield [*i. e.*, interclavicle] is subround and nearly smooth, and belonged to an animal of four feet in length." (Proc. Amer. Philos. Soc., XII, 1871, 177.)

In his extended account of the Ohio Coal Measures amphibia, in 1875, he gave a more detailed description of this plate, and a figure (Rept. Geol. Surv. Ohio, II, pt. ii, Palæon., 401, pl. xl, fig. 4). No further light has since been thrown on this genus nor have any additional specimens ever been obtained.

Some time ago on examining the type, which is preserved in the Newberry collection in the American Museum, it became apparent that it was not an amphibian interclavicle at all, but the operculum of a lungfish. The occurrence of dental plates, scales and various other lungfish remains in the same formation lent support, if any was needed, to this interpretation.

In the following notes the evidence is presented that this plate represents a lungfish, not an amphibian, and the occasion is taken also to discuss the other lungfish remains from the same formation, most of which belong in the genus *Sagenodus*.

A word may here be said, parenthetically, as to the locality from which all these remains are derived. The specimens were collected about 45 years ago from coal mines — notably one known as the "Diamond Mine" — which have been closed now for many years. The locality is generally referred to in books as Linton, Jefferson Co., Ohio. But in 1905 when I visited it I found that the name Linton had been given up decades ago, and was hardly remembered by any one, the locality having been known for a long time as Yellow Creek. None of the coal mines is at present operated, so that it is impossible today to obtain additional specimens.

I. The Supposed Amphibian Genus *Eurythorax* Cope, Based on a Lungfish Operculum.

The type of *Eurythorax sublævis* Cope (No. 8605, Amer. Mus.), is represented in outline, natural size, in Figure 1. It is a thin plate, 72 mm. in height by 78 in width (slightly restored). It is 4 mm. at its thickest part, in the middle, whence it thins gradually, but not uniformly, in all directions toward the margins. The outer face, which is embedded in the matrix, is slightly convex; the inner is flat. The plate is also perhaps a little flattened, due to pressure. The outer face bears minute punctæ, such as may be seen on the outer faces of other ctenodont opercula. The inner, bears a scattering of incised lines and punctæ radiating from the area below the elevation on its dorsal margin. Cope mistook the inner surface for the outer, saying: "Some delicate radiating grooves are seen on the exposed surface but they are very shallow." These are of course the radiating striæ to be seen on the visceral aspect of most fish plates.

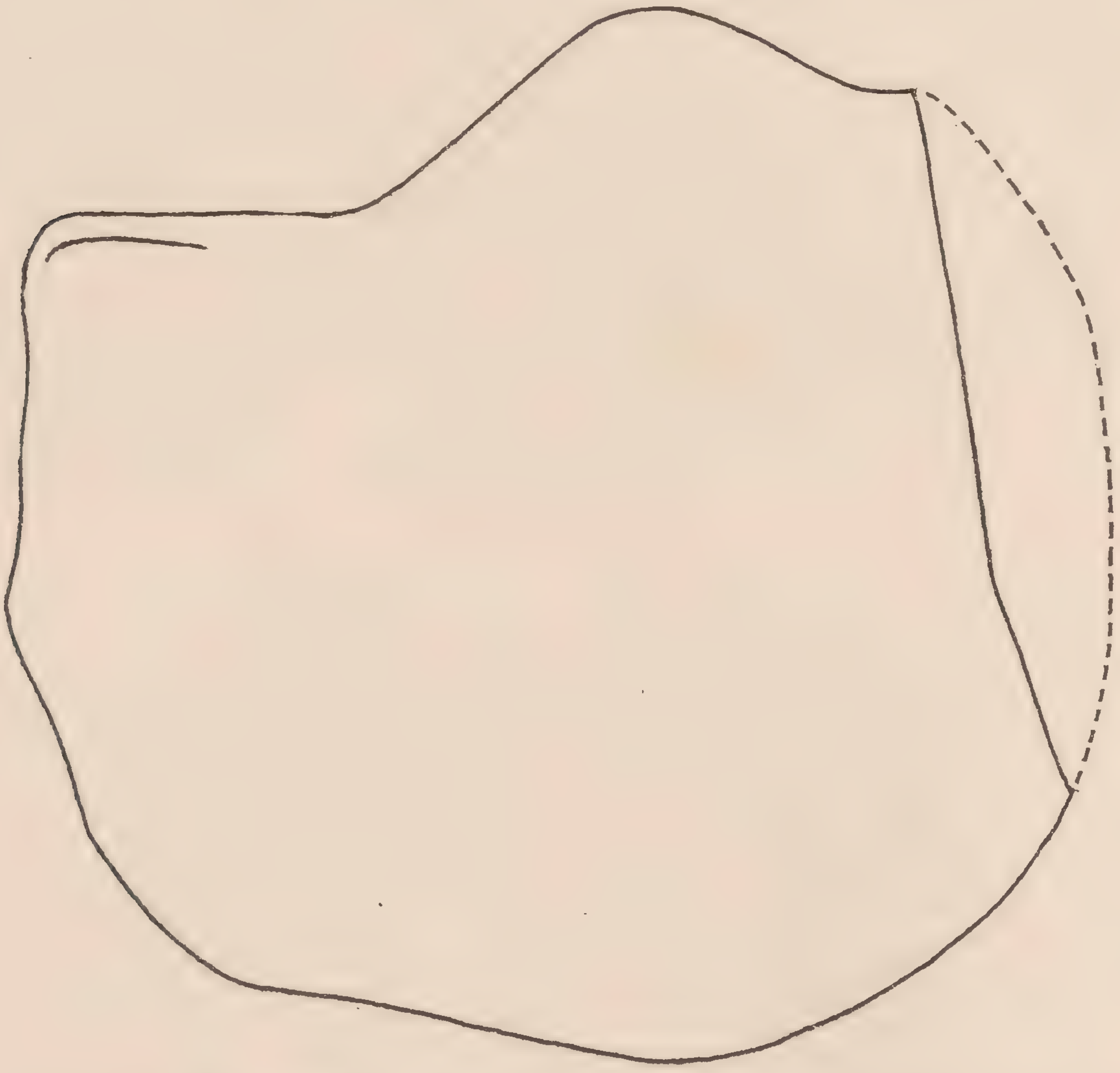


Fig. 1. Operculum of *Sagenodus*. Supposed by Cope to be an amphibian interclavicle, and named *Eurythorax sublævis*. Natural size; No. 8605 Newb. Coll.

I have carefully compared the plate with two opercula of *Sagenodus* (*Ctenodus*) from the Newsham Coal of England (No. 7800, Amer. Mus.). The latter are both larger, but have about the same proportions of height to width. The Ohio specimen resembles them in outline, although it differs in details as would be expected in a different species, or, may be, a different genus; but there seems no doubt of its similarity to these elements and of its being the operculum of a lungfish.

The element also agrees with two ctenodont opercula figured by Fritsch (Fauna der Gaskohle, Bd. 2, 1889, pl. 76, figs. 6 and 7). These figures represent two opercula, in inner and outer view, respectively, from the Permian of Bohemia. Fritsch refers them to *Ctenodus obliquus* Hancock and Atthey. Whether this identification be correct or not, the opercula he figures certainly resemble the Ohio one. Like the latter, they show minute punctæ on the outer convex side and radiating lines on the inner.

To sum up — it is obvious on comparison with ctenodont opercula that the plate thought by Cope to be the interclavicle of an amphibian and which he made the type of the genus *Eurythorax*, is really the operculum of a ctenodont fish, probably *Sagenodus*. It differs from the opercula with which it has been compared in minor details, and must be regarded as a distinct species, to be known as *Sagenodus sublævis* (Cope). Should future discovery prove that the other lungfish remains from the Linton beds belong to the same fish, then this name will have to stand for all of them for reasons of priority.

II. OTHER LUNGFISH REMAINS FROM THE OHIO COAL MEASURES.

Besides the operculum just discussed, a number of other remains of lungfishes — crania, dental plates, scales, etc. — have been described from the Linton beds, by Newberry and by Cope. Several of these have been given specific names. Since they have never been found associated in one fish, and as it is possible that more than one species of lungfish lived in these waters, we must, provisionally at least, retain the several specific names. But it will be useful to bring together in one place a discussion of all these elements and also to put on record several specimens not previously described.

Crania.

Crania are very rare in the Ohio Coal Measures. Only two have been described, and these are perhaps the only ones ever collected.

In 1874, Cope described the larger portion of a cranium under the name *Ctenodus ohiensis* (Proc. Acad. Nat. Sci. Philad., 1874, 91). He further described, and figured it, in 1875 (Rept. Geol. Surv. Ohio, II, pt. ii, Palæon., 410, pl. xlv, fig. 2). A second specimen was briefly described by Newberry, who gave an outline drawing of the cranial plates (Paleoz. Fishes N. Amer., 1889, 227, fig. 3).

The latter specimen consists of the impression of the right half of a large cranium, preserved in the American Museum (Nos. 8540 and 8541). It has probably suffered some deterioration since Newberry figured it, but not much; and it appears that Newberry's figure, like the one given here (Fig. 2), was made from half of the cranium, the drawing then being folded over and the other half traced from it, thus giving the appearance of having been made from a complete instead of a half specimen.

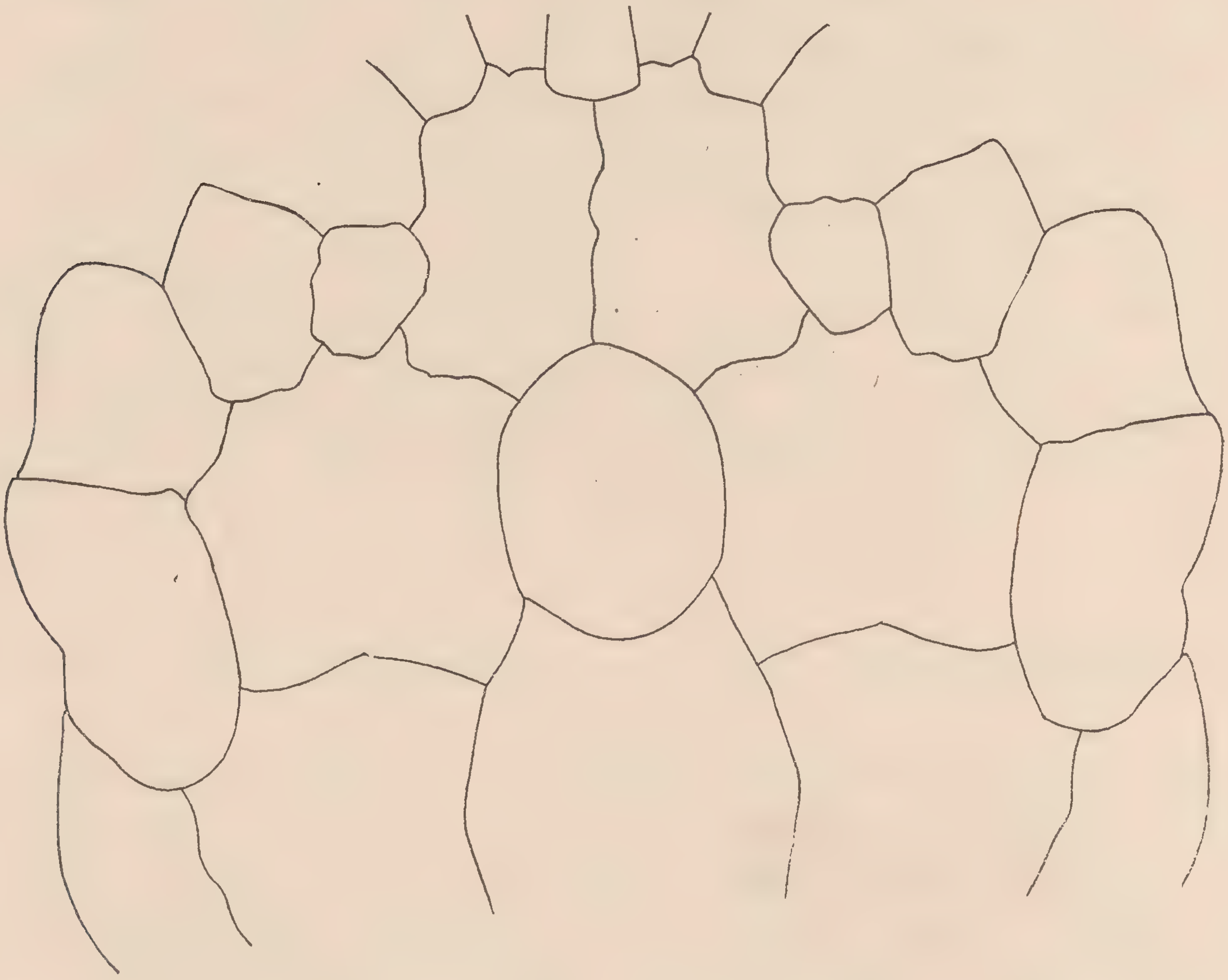


Fig. 2. Cranial plates of *Ctenodus ohiensis* Cope. Drawn from No. 8540 Newb. Coll., which shows only the right half of the cranium. The lateral margins are based on Cope's published figure of another specimen. × ½.

The entire cranium measured about 16 cm. in length. On the assumption that the ratio of the head to the rest of the body was about as in *Neoceratodus*, *Sagenodus ohiensis* must have been a fish over 4 feet in length, or as large as the largest specimens of *Neoceratodus*.

Dental Plates.

The lungfish teeth found at Linton, Ohio, were named by Newberry *Ctenodus serratus*. They clearly belong in the genus *Sagenodus* as now understood. The type, a tooth on a piece of coal, in counterpart, is in the

Newberry collection — No. 481 (Fig. 5). Two other dental plates (Nos. 7463 and 7464) and the impression of a third (No. 1887), all smaller than the type, are also in the collection. The three specimens bring out the fact, seen also in other species of *Sagenodus* dental plates, that the smaller teeth are relatively broader than fully grown ones. (*Cf.* Fritsch's Faune der Gaskohle, Bd. 2, 1889, pl. 73).

The type has considerable resemblance to some other species of *Sagenodus* teeth, for instance, to those described by Fritsch, from the Permian of Bohemia and referred by him to *Ctenodus obliquus* Hancock & Atthey (*loc. cit.* pl. 73). It differs from these in the ridges being sharper, and the denticulations fewer, more elongated, and to some extent obliterated.

The species also resembles *Sagenodus fossatus* (Cope), from the Permian of Illinois (Hussakof, Permian Fishes N. America, 1911, pl. 26, figs. 10, 10a, 11), from which it differs chiefly in the ridges being less developed and the denticulation not so plainly marked. It is probable that *Sagenodus serratus* is a direct forerunner of the Illinois Permian species.

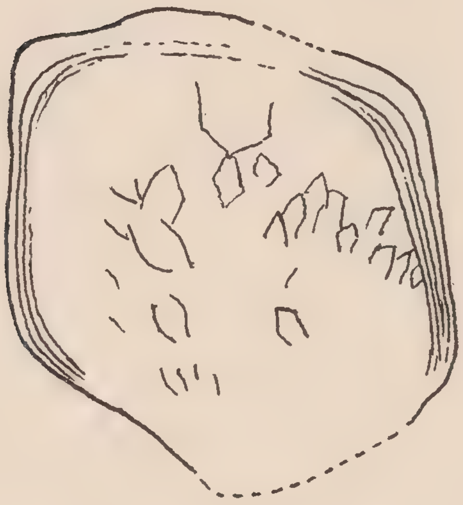
There is also in the Newberry collection a specimen (No. 7461) from the Linton Coal, labeled in Newberry's hand *Ctenodus reticulatus.* He had apparently intended to describe it, perhaps when a more complete specimen turned up, under this name. The specimen is in counterpart. It is very incomplete, shows three very low, rounded ridges radiating from a center, each ridge capped by a wavy, vermiculating line. The specimen is perhaps not a dental plate at all but a fragment of an amphibian scute; the ridges are altogether too low and irregular for a dental plate. This specimen, accordingly, may be ruled out, and we need not modify our view that only a single species of lungfish dental plate is represented in the Linton Coal Measures.

Scales.

Several well-preserved scales from the Linton Coal Measures are extant. The best one was described and figured by Newberry, in 1873, under the name *Rhizodus quadratus* (Rept. Geol. Surv. Ohio, I, Pt. ii, Palæon., 343, pl. 39, fig. 8). This scale and the others of the same kind are now known to belong to lungfishes, and to be referable to the genus *Sagenodus.*

Three such scales are in the Newberry collection in the American Museum. One, preserved in counterpart (Nos. 467 and 467a), is a fine, large scale shown natural size in figure 4. It is very like the type figured by Newberry, although some slight differences from Newberry's figure make it uncertain that it is the type. It measures 49 mm. in height by 48 in width.

A second scale (No. 8529), is smaller and more polygonal (Fig. 3). It



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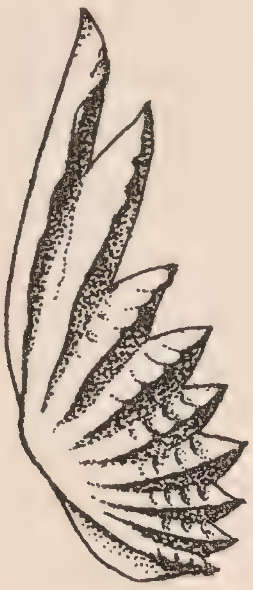

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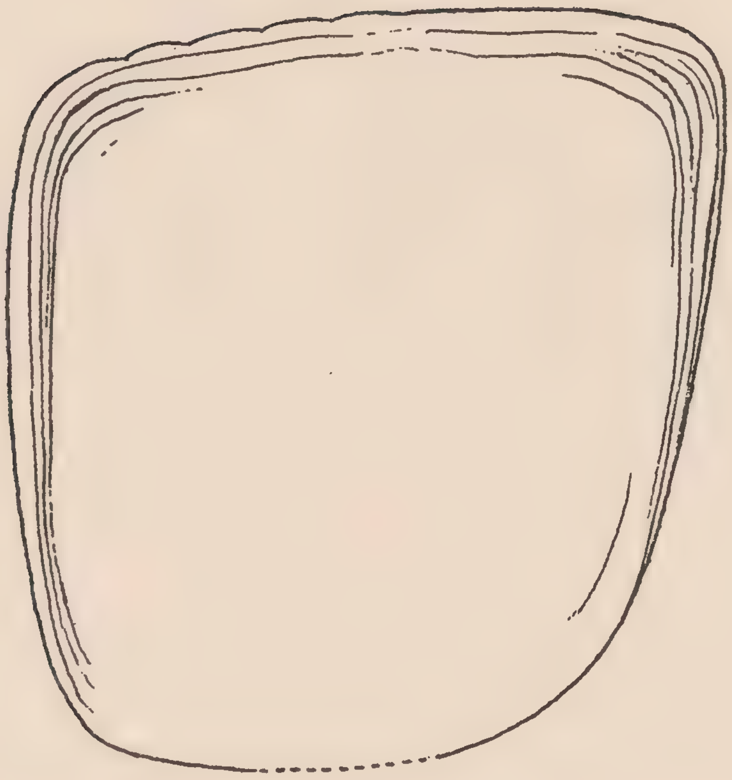

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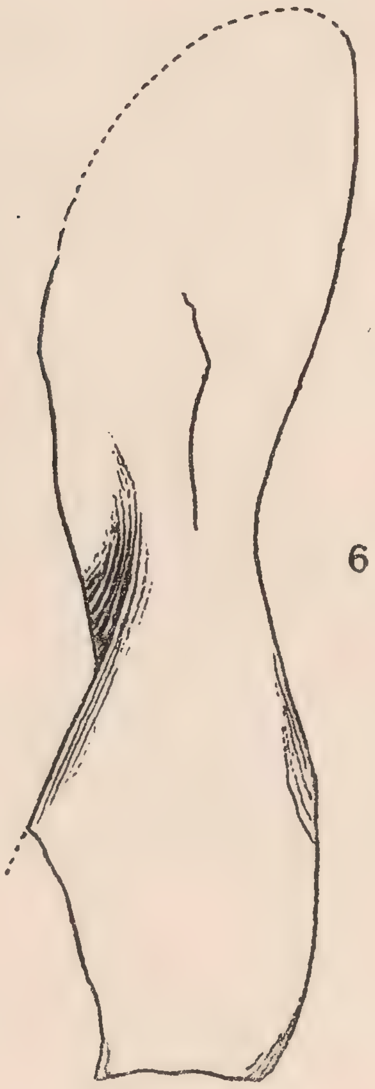

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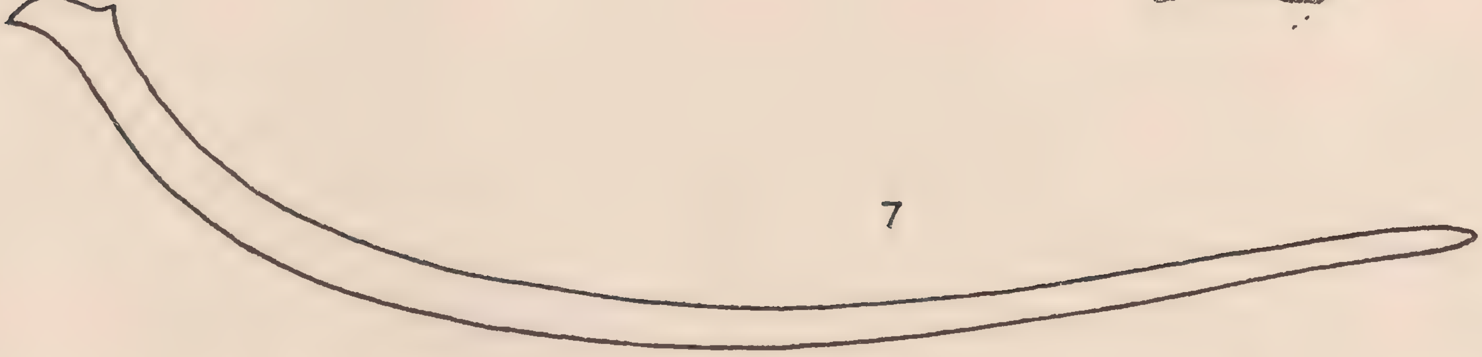

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Figs. 3, 4. Scales of *Sagenodus*, natural size. Nos. 8529 and 467 Newb. Coll. The original of Fig. 3 shows the very fine basal fibrillæ, but these are omitted in the figure.

Fig. 5. *Sagenodus serratus* Newb. Drawn from a squeeze of the counterpart of the type, No. 481 Newb. Coll. Natural size.

Fig. 6. Cleithrum of *Sagenodus?* Natural size. No. 8471 Newb. Coll.

Fig. 7. Rib of *Sagenodus*, natural size. Based on two specimens on a piece of coal, No. 8697 Newb. Coll.

measures 32 mm. in height by 29 in width. A third, consists of half of a fine scale similar in size and form to the first of the above mentioned scales.

These scales, between them, show considerable of the finer structure; one can make out the polygonal reticulations and the fine basal fibrillæ. The fine structure of the *Sagenodus* scale was first made known by Fritsch, who figured all the minute details of the scale in exquisite perfection. He also figured the fine detail of the *Neoceratodus* scale for comparison, and proved that the early fossil lungfishes had scales identical in minute structure with those of the living Australian lungfish (Fritsch, *loc. cit.*, pl. 80).

Recently, Cockerell in the course of his studies on the scales of fishes has investigated those of *Sagenodus* on specimens from the Waverly of Mazon Creek, Illinois.[1] His observations entirely substantiate those of Fritsch. The scale of *Sagenodus,* he says, "in appearance and structure essentially agrees with the scale of the living (Australian) *Neoceratodus*. The reticulations are evident and the very fine basal longitudinal fibrillæ are minutely tuberculated."

Cleithrum.

There is in the Newberry collection, the cleithrum of a fish from the Linton Coal (No. 8471), which probably belongs to *Sagenodus*. It is represented, natural size, in figure 6. It is apparently the cleithrum of the left side, shown in outer view. It resembles fairly well the same element in *Polypterus*.[2]

Ribs.

A piece of coal in the collection, from Linton, bears two incomplete ribs, apparently of *Sagenodus* (No. 8697). One lacks only the distal extremity, but the head is well shown. The other consists of the distal two-thirds of a rib. Figure 7, is based on both specimens. They agree well with the ribs figured by Fritsch from the Permian of Bohemia (*loc. cit.*, pl. 79).

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[1] Additional note on reticulated fish scales, Science, n. s., XXXIV, 1911, 865. See also his paper, The scales of the Dipnoan fishes, Sci., n. s., XXXIII, 1911, 831–832.

[2] *Cf.* figures of shoulder girdle of *Neoceratodus* and *Polypterus* given by W. K. Gregory in his paper, Present status of the problem of the origin of the Tetrapoda, Ann. N. Y. Acad. Sci., XXVI, 1915, figs. 5 and 6.

56.7,45C(117:56)

Article XV.— A NEW PYCNODONT FISH, *CŒLODUS SYRIACUS*, FROM THE CRETACEOUS OF SYRIA.

By L. Hussakof.

A dental plate of a pycnodont fish was recently sent to me for examination by Mr. George Haddad of Rutland, Vt. He collected it while on a visit to Syria, two years ago, at a place about eighteen miles southeast of the city of Beyrout. The specimen is a right splenial in almost perfect preservation. It seems originally to have been embedded in a small limestone concretion, but had weathered out so completely that only a very little of the rock clings to the oral face and around the margins; the underside is entirely free.

The occurrence of the specimen in limestone, taken in conjunction with what we know of the geology of Syria, indicates that it is of *Cretaceous* age. It represents a new species of *Cœlodus,* which may be described as follows:

Cœlodus syriacus n. sp.

A species known only by a large, right splenial dentition. Teeth of principal series not quite three times as broad as long, their anterior margins straight or only slightly concave. This series separated from inner margin of the element by a space equal to the width of a tooth in the posterior half, but somewhat less than a tooth in the front half of the element. Eight teeth in the principal series; anteriormost about $\frac{2}{3}$ the width of the hindmost. Two outer flanking series, their combined width about $\frac{3}{4}$ that of the principal series. Teeth of inner flanking series transversely elongated, $1\frac{1}{2}$ times as broad as long; those of outer series not elongated, triangular or quadrate in form, with rounded angles. A single, small, nearly circular, unworn tooth inside of the principal series, placed opposite the space between the third and fourth teeth of this series.

Teeth of principal series smooth, or with a scattering of irregular indentations (perhaps

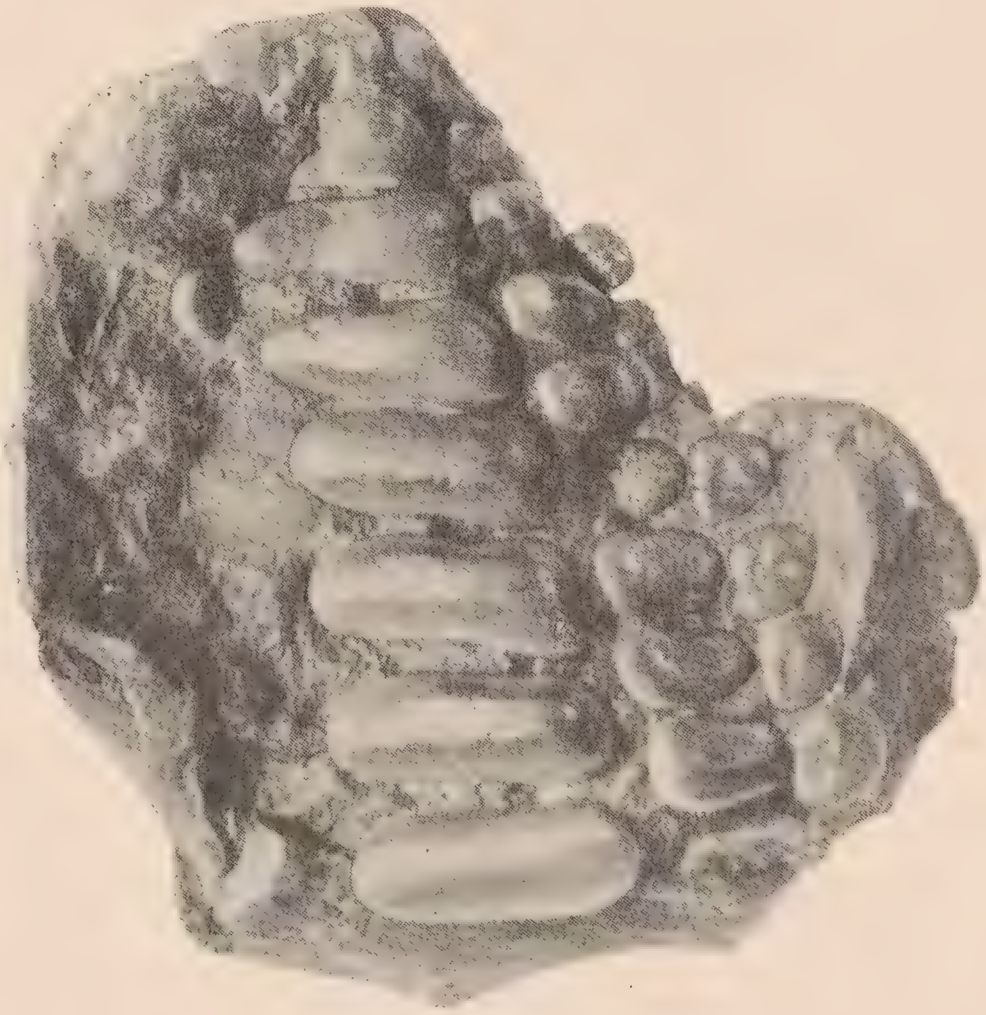

Fig. 1. *Cœlodus syriacus*, n. sp. Type. Right splenial dentition, natural size.

due to wear). Teeth in the other rows with a central depression from which crinklings radiate toward the margin; these markings more or less obliterated, or entirely worn away, depending on the amount of use.

Measurements of the Type.

	mm.				
Length of principal series, 8 teeth	63				
Front tooth of principal series	12.5	wide	by	6	long
Last " " "	20.5	"	"	8.5	"
Next-to-last tooth " "	20	"	"	7.5	"
Last preserved tooth of inner flanking series	10	"	"	7	"
Last preserved tooth of outermost series	6.5	"	"	7	"
Width of both flanking series (hindmost teeth)	16.5				

No species of *Cœlodus* has heretofore been described from Syria, although the genus was known to occur there since it is stated by Woodward (Catal.

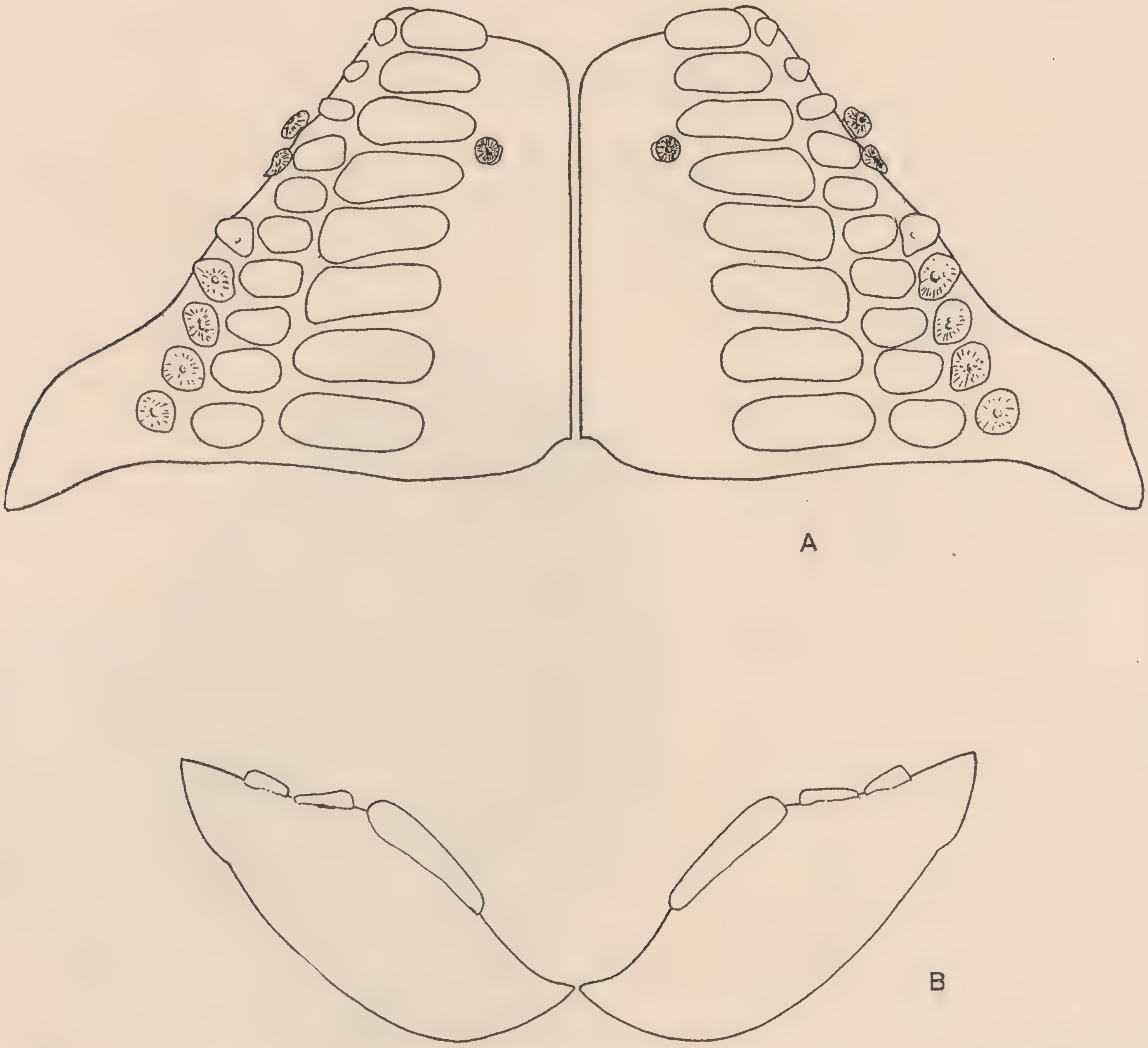

Fig. 2. *Cœlodus syriacus.* Diagram of the complete lower dentition. A, viewed from above. The amount of wear of the teeth corresponds with that exhibited by the type specimen. B, section taken at about two-thirds back from anterior margin, with the splenials apposed approximately as in life. × about $\frac{2}{3}$.

Fossil Fishes Brit. Museum, Pt. III, 258), that "An undescribed species of *Cœlodus* is represented by portions both of the upper and lower dentition from the Cretaceous near Beyrout, now in the Museum of the Syrian Protestant College, Beyrout." It appears probable that this is the same species as is here described.

The genus *Cœlodus* ranges from the Upper Jurassic through the Cretaceous and is represented in Europe, Asia and North America. About 30 species are known. The present one differs from all others by the wide separation of the principal series of teeth from the inner margin of the splenial, and by the proportions of width to length of the principal and flanking series.

It is interesting to note that although the species clearly belongs in the genus *Cœlodus,* it none the less approaches *Anomœodus* in some features, for instance, in the wide separation of the principal series of teeth from the oral margin of the splenial and in the great transverse elongation of these teeth. Also, one of the anterior teeth in this series is somewhat pointed and directed obliquely forward. All these features go to connect the genus *Cœlodus* with *Anomœodus.*

The type and only known specimen is in the possession of Mr. George Haddad of Rutland, Vt., to whom I am greatly indebted for the privilege of studying it. A carefully made cast of it is in the American Museum of Natural History.

59.7(72.2)

Article XVI.— SHORE FISHES COLLECTED BY THE 'ALBATROSS' EXPEDITION IN LOWER CALIFORNIA WITH DESCRIPTIONS OF NEW SPECIES.[1]

By Raymond C. Osburn and John Treadwell Nichols.

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The 'Albatross' expedition to Lower California in the spring of 1911 was unusually successful in the number and variety of the fishes taken in the shore waters of that region. The present list contains 185 species taken between the dates of March 2 and April 26, inclusive. Of this number fourteen species and one variety appear to be new and are here described.

Besides these, there is much of interest in the collection, as numerous rare species known only from one or two, often more or less distant, localities were obtained, thus adding to our knowledge of their distribution. Also one well known Atlantic species, *Hemirhamphus balao* Le Sueur, is here recorded from the Pacific for the first time, and the range of a number of the common western species extended.

Undoubtedly the richness of the collection, accumulated within so short a time, is due in large part to the fact that various methods for the capture of fishes were constantly employed side by side wherever possible. Seining naturally produced the best results. Hand-line fishing was resorted to, and an electric-light lure made by immersing a strong electric light bulb in the water at the side of the ship at night attracted numerous species which were then taken in a dipnet. A boat dredge and a three and a half foot Tanner beam trawl were used in shallow water. Some species were picked up on the beach and other small ones were taken in their natural habitat in the tide pools or at the edge of the shore. Certain others living among the rocks were obtainable only by the use of dynamite. Each of these methods of collecting yielded species not taken in any other way. The method of capture is given in most cases in the following list, and reference to it will disclose the fact that usually any single species was taken by only one method.

The numbers given in this paper are not intended to show the relative abundance of individuals of the various species. In the case of common, well-known species, frequently only a single specimen from any locality was preserved for study. The economic aspects of the fisheries will be dealt with elsewhere.

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[1] Scientific Results of the Expedition to the Gulf of California in charge of C. H. Townsend, by the U. S. Fisheries Steamship 'Albatross' in 1911. Commander G. H. Burrage, U. S. N., Commanding. No. VI.

As indicated in the title, only the fishes from the shallow waters along shore are here included. While the small trawl and boat dredge were frequently employed in collecting, the lowest depth considered in this report is only thirteen fathoms (in Magdalena Bay). The fishes of the deeper waters will constitute a separate report.

Practically all the shallow water collecting was done along the coasts of the Lower California peninsula and the closely associated islands. The only exceptions are Guadalupe Island, which lies about a hundred and forty miles to the west of the peninsula, and Tiburon and San Esteban islands, which are more closely related to the mainland of Mexico, two thirds of the way toward the head of the Gulf of California.

The accompanying chart will indicate the course of the trip and the positions of the various stations. Guadalupe Island was first visited on a special trip, after which attention was directed entirely to the work about the peninsula. Passing down the west side, then along the eastern shore as far north as the island of Angel de la Guardia, the 'Albatross' crossed the gulf to Tiburon Island. A stop was made for coaling at Guaymas on the mainland of Mexico, but no collecting was done. The vessel then recrossed to the peninsula and made several more stations. Three of the earlier stations were revisited on the return trip, viz., Pichilinque Bay, San Jose del Cabo and Port San Bartholome. Following is a list of the stations,[1] with date of arrival:

Guadalupe I.	March 2
San Benito I.	“ 9
Cerros I.	“ 10
Port San Bartholome	“ 13
San Cristobal Bay	“ 15
Ballenas Bay	“ 18
Cape San Lucas	“ 23
San Jose del Cabo Bay	“ 25
Pichilinque Bay	“ 27
San Josef I.	“ 30
Agua Verde Bay	April 1
Carmen I.	“ 2
Mulege	“ 4
Concepcion Bay	April 5
San Francisquito Bay	“ 9
Angel de la Guardia I.	“ 10
Tiburon I.	“ 11
San Esteban I.	“ 13
Santa Catalina I.	“ 16
Santa Cruz I.	“ 16
Pichilinque Bay (repeated)	“ 17
Espiritu Santo I.	“ 19
Ceralbo I.	“ 19
San Jose del Cabo (repeated)	“ 20
Port San Bartholome (repeated)	“ 23

The fisheries of the Lower California region are almost wholly undeveloped. Food fishes of excellent quality and often of large size are very abundant. A glance at the lists under the Scombroid, Serranid, Lutianid,

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[1] See also the map accompanying the Narrative of the Voyage, by Dr. C. H. Townsend, to be published later in the present volume of this Bulletin.

Hæmulid and Sciænid groups will serve to indicate how varied and numerous are the economic species.

In the preparation of this report we have been greatly aided by the notes taken during the work of collecting by Dr. Chas. H. Townsend, in charge of the expedition. Many color notes on the fresh specimens were made by Dr. Townsend and some of these have been incorporated in the following text.

The illustrations of the new species are the work of Mr. K. Kimoto, under the personal supervision of the junior author. The funds for this work were supplied by the American Museum of Natural History, in which institution the types of the new species are placed.

The list of new species is as follows:

Raja microtrachys
Urobatis concentricus
Letharchus pacificus
Bascanichthys bascanoides
Fundulus parvipinnis, subsp. brevis.
Tylosurus pterurus
Siphostoma exile
Atherinopsis sonoræ
Amia guadalupensis
Girella simplicidens
Hermosilla robusta
Callyodon compressus
Callyodon microps
Dactyloscopus cinctus
Lucioblennius lucius

HETERODONTIDÆ. BULL-HEAD SHARKS.

Gyropleurodus francisci (*Girard*). BULL-HEAD SHARK.

Magdalena Bay, March 12, one specimen eight inches long, dredged at 13 fathoms.

GALEIDÆ. REQUIEM SHARKS.

Galeus dorsalis (*Gill*).

Tiburon I., April 12, a female three feet long, taken on a hand-line, contained six unborn young, each ten inches in length.

Triakis semifasciatum *Girard.* CAT SHARK.

East side of Cerros I., March 11; Port San Bartholome, March 13 and 14 and again on April 23, and Ballenas Bay, off Abreojos Pt., March 16, all taken in the seine.

Prionace glauca (*Linnœus*). GREAT BLUE SHARK.

Carmen I., April 3, a young specimen taken on a hand-line.

RHINOBATIDÆ. GUITAR FISHES.

Rhinobatis productus *Ayres.* GUITAR FISH.

East Side of Cerros I., March 12; Port San Bartholome, March 13 and again on April 23, and Agua Verde Bay, April 1. Taken on hand-lines and with the seine.

RAJIDÆ. SKATES.

Raja microtrachys sp. nov.

Fig. 1.

Cartilages weak, notably those of the snout, and structure generally loose. A deep water form allied to *isotrachys* and *trachura,* but lacking the mid-dorsal tubercle, with more white below and with other minor differences. Probably closely related also to the cotype of *R. aguja* Kendall and Radcliffe, Mem. Mus. Comp. Zoöl., Vol. 35, No. 25, pl. i, fig. 2.

Disk rhomboid, width about 1.2 times length to end of pectorals. Anterior edges meeting in an angle a little greater than 90 degrees, but slightly sinuated so that the angle of the snout is less than 90 degrees. On the hinder part of the snout the margin curves outward and is again somewhat incurved back of the spiracles. Outer and hinder angles of the pectorals broadly rounded, outer margin nearly straight. Snout moderately produced and pointed, the tip blunt, about 3.75 in length to posterior edge of pectoral. Tail from vent a little longer than the rest of the body, depressed, the lower surface nearly flat, with dermal keels posteriorly which are broad and fin-like near the end of the tail. Dorsal fins far back, contiguous (the margins too much broken to permit the form to be determined), origin of first dorsal a distance from the caudal equal to 1.4 in the snout. Pelvic fin deeply notched, separating a pointed fleshy anterior lobe which, measured from the bottom of the notch, is 2.6 in snout.

Orbit 4 in snout, interorbital the same, concave. Spiracle 1.5 in orbit. Preoral distance slightly greater than snout; mouth straight, 1.6 in preoral distance, equal to internarial space. Mesial nasal flaps large, the hinder limb with a fringe of broad, mostly bifid, papillæ, directed forward. Corners of mouth guarded by well-developed flaps; other flaps at the outer posterior margins of nares. Teeth small, with flat crowns and with backwardly directed cusps on their hinder margins.

Upper parts everywhere roughened with fine stellate prickles, these smallest and sparsest on the bases of the pectorals, largest and most closely set on the base of the tail and fine and close set between the eyes. Twenty strong retrorse tubercles on mid vertebral line between anterior pelvic lobes and origin of first dorsal, one or two of these spines apparently missing from spaces at middle of tail and again half way between this and origin of dorsal. No other tubercles anywhere. Anterior lobe of pelvic fin and entire under surface smooth, with the exception of a few scattered prickles along the ventral margins of the tail basally.

Color in spirits dark chocolate brown above, the margins narrowly darker, spiracles pale; underside slate colored, darker toward the margins of pectorals and

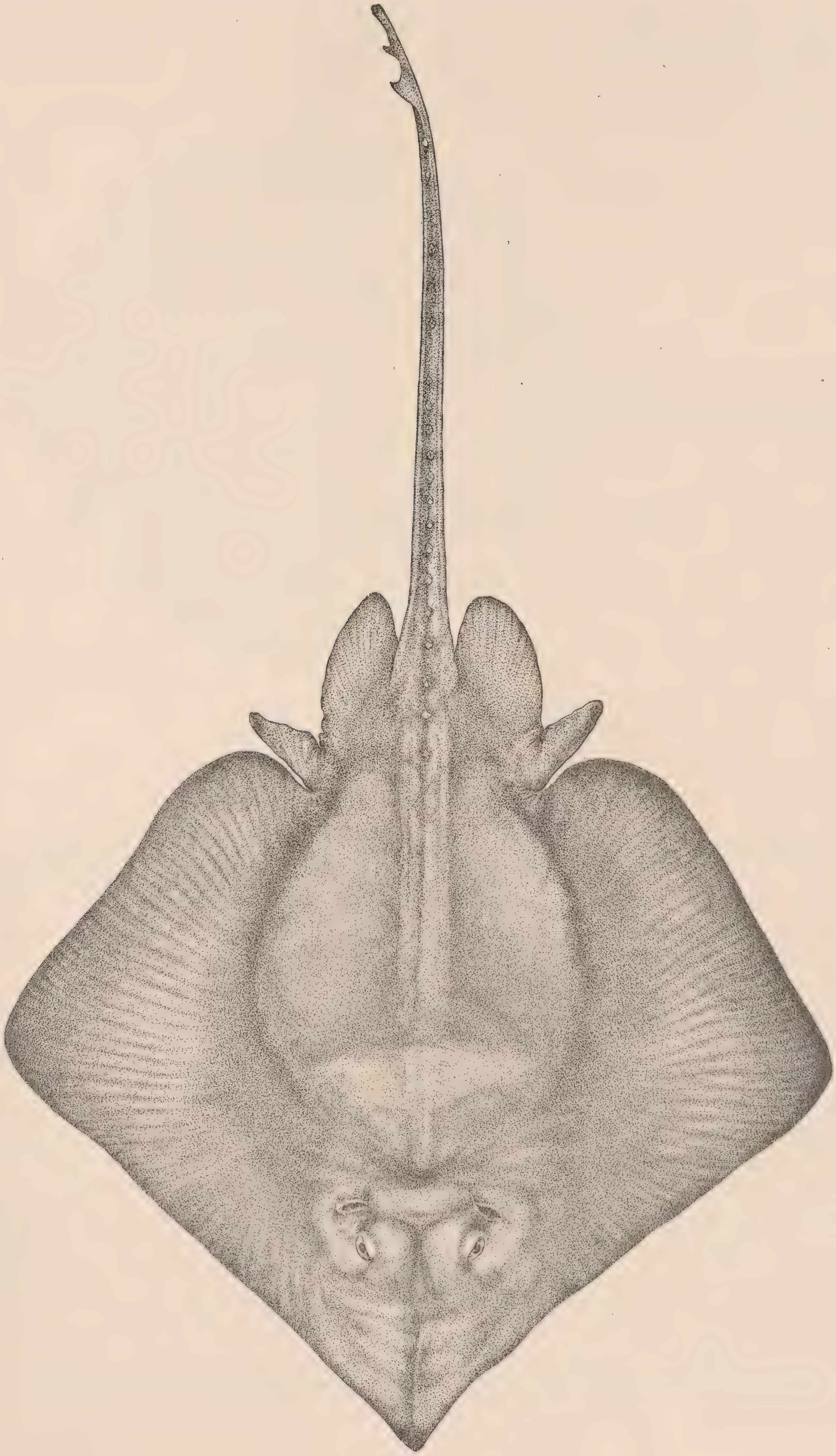

Fig. 1. *Raja microstachys* sp. nov.

on tail; center of disk broadly whitish, sharply contrasted with the slate of the pectorals, extending from about the middle of the snout backward to pelvic girdle and irregularly at the sides onto the anterior lobes of the pelvic fins.

Type No. 5198 American Museum of Natural History. Total length 29 inches. Collected at Guadalupe Island, March 1, 1911.

Our only specimen is an adult female with eggs, one of which measured $1\frac{1}{4}$ inches in diameter.

NARCOBATIDÆ. ELECTRIC RAYS.

Narcine entemedor *Jordan and Starks.*

Agua Verde Bay, April 1, and Mulege, April 4, seined.

Discopyge ommata *Jordan and Gilbert.*

Santa Cruz I., April 16, one specimen.

DASYATIDÆ. STING RAYS.

Urobatis concentricus sp. nov.

Fig. 2.

Disc subcircular, anterior edges straight, meeting at snout in an obtuse angle. Breadth of disc about equal to length to base of tail. Tail to tip of caudal 1.4 in length of disc. Snout 4.5 in body to base of tail. Interorbital width 1.4 in snout. Snout from eye equal to snout from mouth. Width of mouth 1.6 in distance to tip of snout. Eye 4 in snout, equal to or slightly smaller than spiracle.

Teeth small, numerous, tessellated, with acute triangular cusps.

Tail with moderately developed lateral folds, extending backward to insertion of spine, which is about midway between the pectoral axil and the tip of the caudal. Caudal oblong, rounded at tip, its depth 2.5 in snout. Spine strong, retrorsely serrate, its length on dorsal ridge equal to interorbital width.

Skin everywhere smooth. Ground color in alcohol dark brown, broken into coarse reticulations on middle of disc by large rounded pale spots which average in diameter about one half the interorbital width. These spots are arranged more or less definitely in 3 concentric circles around a central one in the middle of the disc. Two narrower pale unbroken bands, concentric with these, on the edge of the disc, extending on the ventrals. Under side pale with a brown margin $\frac{3}{4}$ inch wide in a specimen 17 in. long and extending forward to opposite mouth. Extreme margin of disc and ventral fins pale. Under surface of tail pale, caudal dusky.

Type No. 5199 Am. Mus. Nat. Hist.

Length 17 inches, from the east side of Esteban Island, April 13, 1911.

We have two other specimens, 16 and 14½ inches in length, from the same locality. All three are males.

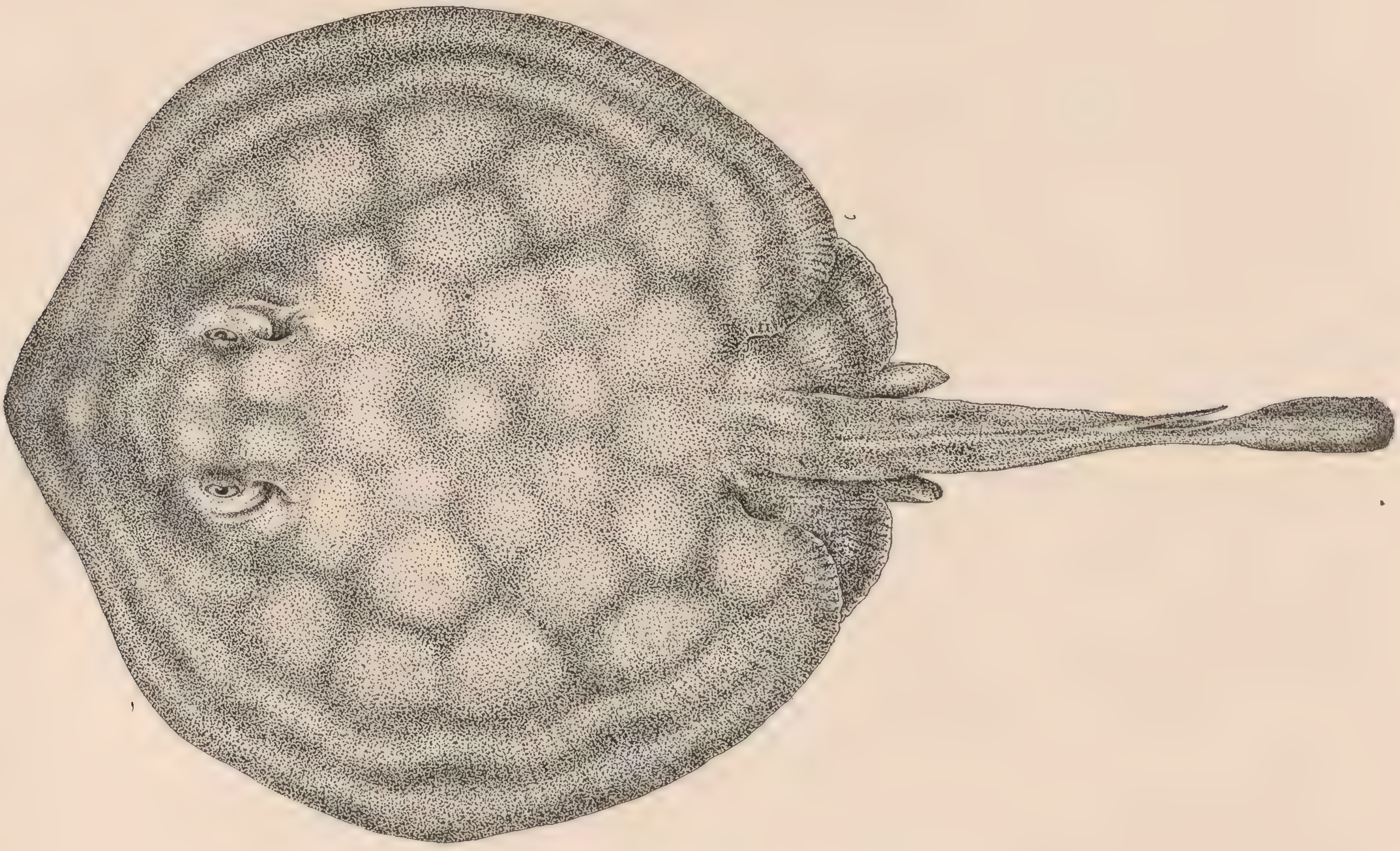

Fig. 2. *Urobatis concentricus* sp. nov.

Urotrygon mundus (*Gill*).

Port San Bartholome, March 14, one specimen seined, and east side of Esteban I., April 13.

Dasyatis dipterura *Jordan and Gilbert.*

Mulege, April 4, one specimen seined.

Pteroplatea marmorata *Cooper.* Butterfly Ray.

Port San Bartholome, March 13, one specimen seined.

Myliobatidæ. Eagle Rays.

Myliobatis californicus *Gill.*

Port San Bartholome, March 14 and again on April 23, several specimens, and Santa Maria Bay, March 18, one specimen. All were taken in seining.

SILURIDÆ. CATFISHES.

Netuma platypogon (*Günther*).

A single specimen taken at Pichilinque Bay, March 27, on a hand-line.

LEPTOCEPHALIDÆ. CONGER EELS.

Congrellus balearicus (*De la Roche*).

Cape San Lucas, March 23, one mutilated specimen, only the head and about an inch of the body being obtained.

MYRIDÆ. WORM EELS.

Myrophis vafer *Jordan and Gilbert.*

Pichilinque Bay on March 27 and again on April 18, a number of specimens taken at night by the use of the electric light lure.

OPHICHTHYIDÆ. SNAKE EELS.

Sphagebranchus selachops (*Jordan and Gilbert*).

Two specimens taken at Cape San Lucas on March 23.

Letharchus pacificus sp. nov.

Fig. 3.

Teeth conical, directed inward and backward. Snout slender, pointed, projecting $\frac{2}{3}$ of its length beyond the lower jaw, cleft of mouth longer than snout, extending back of the eye a distance about equal to the diameter of the latter. Gill openings sub-inferior, diverging at about an angle of 60 degrees from a narrow isthmus, which is about equal to the eye and $\frac{1}{2}$ the width of the slit. Eye 12; snout about 6, head in trunk $6\frac{1}{2}$; tail $1\frac{2}{3}$ in trunk; depth $2\frac{1}{2}$ in head. Lateral line conspicuous. Dorsal beginning behind the eye a distance equal to snout, high at nape, gradually lower backward, practically absent on posterior $\frac{2}{3}$ of tail. Pectoral and anal fins wanting.

Color in spirits,— head, dorsal and ventral lines and dorsal fin, whitish; sides dark chocolate brown; many dark spots, mostly smaller than eye, on head, confluent to form about four cross bars on throat, closer together on snout and lower jaw; the dark sides with obscure darker specks, the lateral line narrowly pale.

Type No. 5200 American Museum of Natural History, Cape San Lucas, March 23, 1911, 1 specimen, 5½ inches in length.

This species differs somewhat in measurements and notably in color from the only other member of the genus, *L. velifer* Goode and Bean, from the Gulf of Mexico.

Myrichthys tigrinus *Girard.*

Pichilinque Bay, March 27, one specimen taken at the electric light lure.

Bascanichthys peninsulæ (*Gilbert*).

Pichilinque Bay, March 27, a single specimen seven and a half inches long.

Bascanichthys bascanoides, sp. nov.

Fig. 4.

Close to *bascanium* and *scuticaris* of the Atlantic, with pectorals small and trunk elongate.

Trunk subterete, depth 2.2 in length of head, breadth 2.5 in head; tail terete; head and trunk about equal to tail; head contained 11 times in head and trunk. Eye 2 in snout, which is 7 in head; lower jaw reaching to middle of snout, gape about equal to snout. Teeth subequal, short, bluntish conical, slightly recurved, in a single series in the lower jaw with a few extra ones near the symphysis; sides of upper jaw with a single series, separated by a short interspace from two or three near the tip; vomerine teeth in a triple series in front, then double, becoming single toward the posterior, anterior teeth the larger. Gill openings vertical, equal to snout, slightly greater than isthmus. Pectoral rudimentary, situated in upper part of gill opening, slightly longer than eye. Dorsal commencing about midway between gill opening and eye; both dorsal and ventral low.

Color in spirits dark reddish brown, unmarked, darkest dorsally, fading out ventrally to yellowish on belly. Vertical fins pale and a narrow pale vertebral streak the full length of the dorsal. Snout and lower jaw dusky.

Type No. 5201, American Museum of Natural History, collected off San Cristobal Bay, March 15, 1911, total length 30 inches. A single specimen, recorded in Townsend's notes as "taken from the stomach of a jew-fish" (*Mycteroperca venadorum*).

Quassiremus notochir (*Gilbert*).

Carmen I., April 3, one specimen.

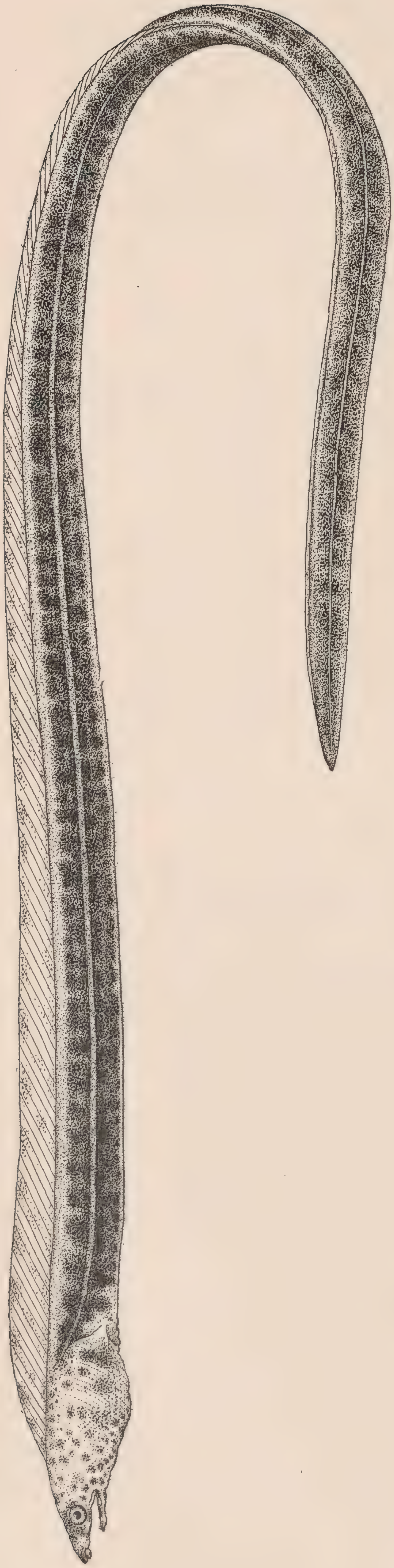

Fig. 3. *Letharchus pacificus* sp. nov.

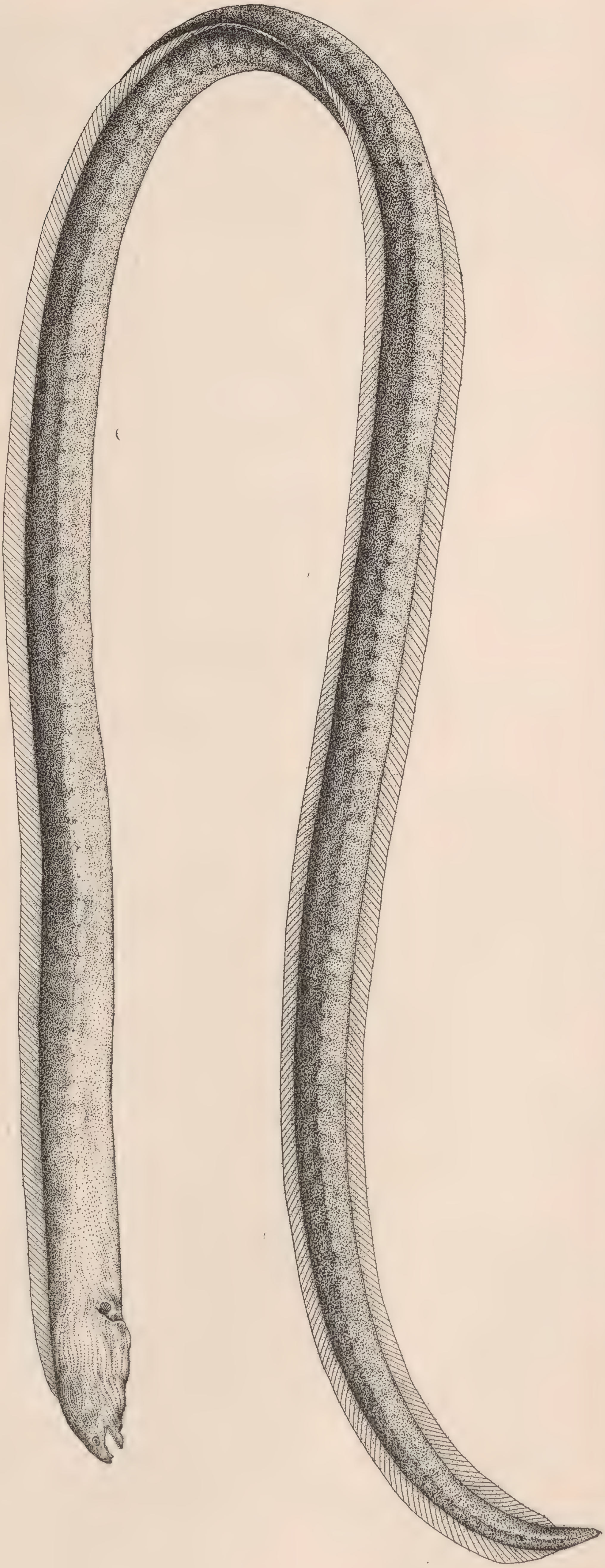

Fig. 4. *Bascanichthys bascanoides* sp. nov.

Ophichthus triserialis (*Kaup*).

Pichilinque Bay, March 27, one specimen about five inches long taken at the electric light lure.

MURÆNIDÆ. MORAYS.

Lycodontis funebris (*Ranzani*). BLACK MORAY.

Agua Verde Bay, April 1, one specimen four inches long, seined.

Uropterygius necturus (*Jordan and Gilbert*).

Agua Verde Bay, April 1, a specimen six inches in length, seined.

ALBULIDÆ. LADY FISHES.

Albula vulpes (*Linnæus*). LADY FISH.

Carmen I., April 3, three specimens, seined.

CLUPEIDÆ. HERRINGS.

Jenkinsia acuminata (*Gilbert*).

Carmen I., April 2, a specimen two inches long, seined.

Perkinsia othonops *R. S. Eigenmann.*

San Benito I., March 9, six dozen specimens, seined.

Clupanodon cæruleus (*Girard*). CALIFORNIA SARDINE.

San Benito I., March 9; Ballenas Bay and Cerros I., March 11, and Santa Catalina I., April 16, numerous specimens both young and adult.

Sardinella thrissina (*Jordan and Gilbert*). SCALED SARDINE.

Pichilinque Bay, March 27; Agua Verde Bay, April 1, and Carmen I., April 2 and 3. Numerous specimens taken with the seine and at Agua Verde Bay they swarmed about the electric light lure at night.

Sardinella stolifera (*Jordan and Gilbert*).

Mouth of Mulege River, April 4, twenty specimens, seined.

Ophisthonema libertate (*Günther*). THREAD HERRING.

Ballenas Bay, March 16, and Carmen I., April 3; two specimens, taken in the seine.

ENGRAULIDIDÆ. ANCHOVIES.

Engraulis mordax *Girard.* CALIFORNIA ANCHOVY.

San Benito I., March 9 and Cerros I., March 11, three specimens, seined.

SYNODONTIDÆ. LIZARD FISHES.

Synodus lacertinus *Gilbert.*

Cape San Lucas, March 23, one specimen seined.

PŒCILIIDÆ. KILLIFISHES.

Fundulus parvipinnis brevis subsp. nov.

Fig. 5.

Body moderately robust, depth 3.4, back elevated. Dorsal fin rising rather steeply from snout to above insertion of pectoral fin, thence gently rounded to insertion of dorsal, slanting downward rather steeply under base of dorsal fin, and thence more gently to base of caudal. Caudal peduncle long and slender, much

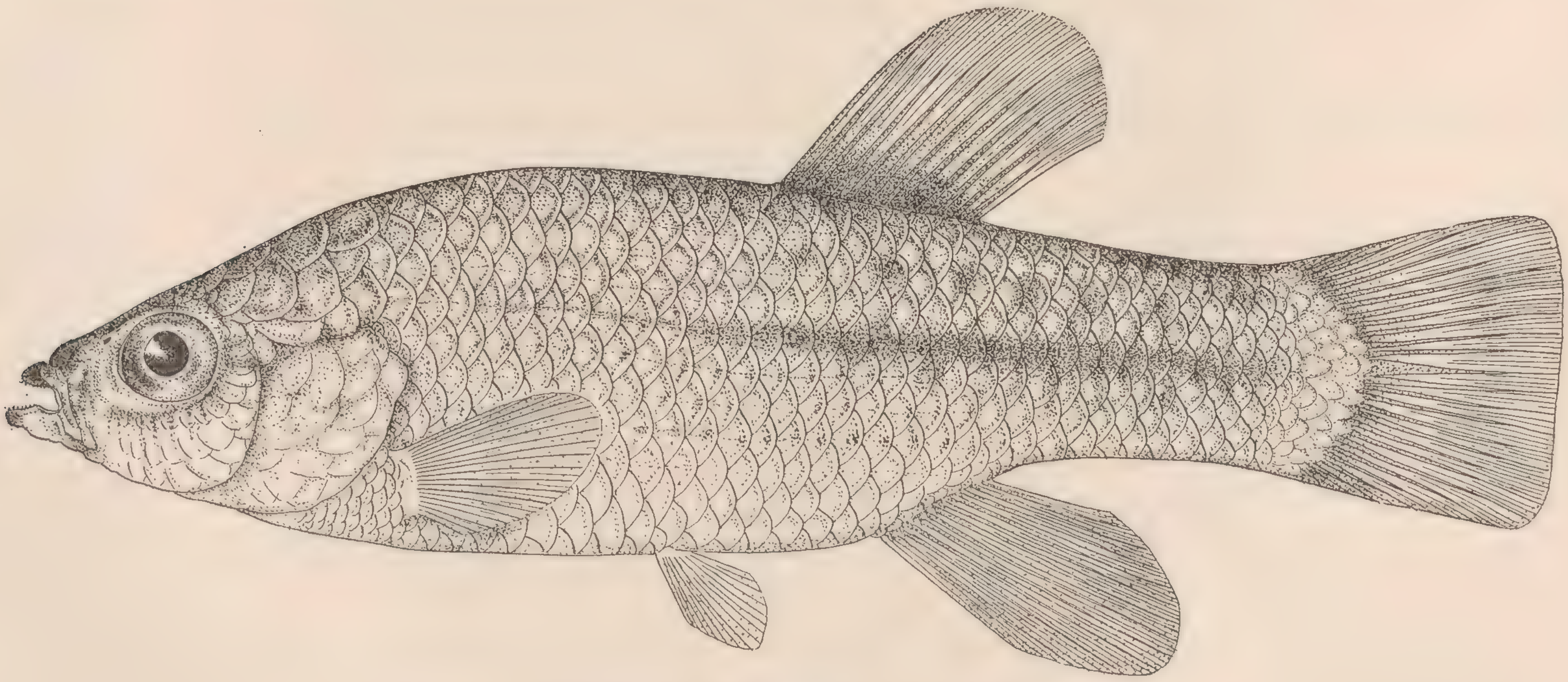

Fig. 5. *Fundulus parvipinnis brevis* subsp. nov.

compressed, its depth 1.5 in its length. Head 3.3, eye 3.8 in head; interorbital 3; snout 3.5; mouth small, tip of snout to end of maxillary 3.5 in head. Scales 32, in 13 series. Pectoral 1.7, not quite reaching to ventral; ventral 2.3, not quite reaching to anal; anal 1.2, of 13 rays; caudal even, 1.5, with 4 rows of small scales in its base; dorsal 1.6, of 13 rays.

Color in spirits brownish, paler below, scales more or less margined with dark punctulations; about a dozen narrow, short, broken, dark bars posteriorly, connected by a lateral streak from above tips of pectorals to base of caudal.

Type No. 5208, Am. Mus. Nat. Hist.

Taken in south end of Magdalena Bay, March 20, 1911, 2.5 inches long. Four others of about the same size taken with it and two dozen of various sizes the following day, off Magdalena.

Our specimens have been compared with a series of specimens of *parvipinnis* from San Diego, Cal., from which they differ in the noticeably shorter and deeper body and in the scale count. The following table is based on the measurements of ten graded specimens of *parvipinnis* and of the subspecies.

	Length of body	*Head*	*Depth*	*Eye*	*Scales*	*Locality*
F. parvipinnis	2.9	3.4	4.0	4.2	37	San Diego
	2.8	3.5	4.0	4.1	36	“
	2.6	3.5	3.7	4.0	35	“
	2.6	3.3	4.1	4.0	36	“
	2.5	3.3	3.6	4.0	34	“
	2.5	3.5	3.9	3.8	37	“
	2.2	3.5	3.8	3.6	34	“
	2.2	3.5	4.0	3.6	35	“
	1.7	3.5	4.3	3.3	33	“
	1.8	3.4	4.0	3.3	35	“
Average	2.38	3.44	3.94	3.79	35.2	
F. parvipinnis brevis	2.7	3.0	3.3	3.5	32	Off Magdalena
	2.5	3.2	3.4	4.0	32	S. end Magdalena Bay
	2.5	3.3	3.4	3.8	32	“ “ “ “
	2.3	3.0	3.2	3.9	33	Off Magdalena
	2.3	3.2	3.1	3.9	32	“ “
	2.1	3.3	3.6	3.5	33	“ “
	1.9	3.1	3.2	3.4	33	“ “
	2.0	3.2	3.6	3.5	30	“ “
	1.7	3.1	3.5	3.5	33	“ “
	1.6	3.3	3.6	3.3	33	“ “
Average	2.16	3.17	3.39	3.63	32.3	

ESOCIDÆ. NEEDLE FISHES.

Tylosurus fodiator *Jordan and Gilbert.*

Cape San Lucas, March 24, four specimens taken in the seine.

Tylosurus pterurus sp. nov.

Fig. 6.

Head 3; depth 1.4 in postorbital part of head; eye large 1.7 in postorbital part of head; snout 3.7 times postorbital part of head, base of upper jaw depressed, the maxillary entirely concealed under preorbital; top of head with a shallow scaly groove. Teeth very small, conical, not compressed, and very even for this genus, about 60 in main row on one side of upper jaw. Pectoral .8 in postorbital part of head; ventrals inserted midway between pectorals and caudal; anal rays 16, inserted distinctly in advance of the shorter dorsal which has 13 rays; distance of insertion of dorsal to upper caudal lobe contained 3 times in its distance behind preopercle; caudal deeply lunate, the lower lobe longer. Scales large, about 185 in lateral line, 102 between nape and origin of dorsal.

Caudal peduncle much depressed, its width slightly more than twice its depth; laterally forming a thin scaled keel-like expansion above the axis of the body. The lateral line very low throughout; beginning on the throat, it sends a vertical branch to the base of the pectoral, curves upward to avoid the base of the pelvic fin and posteriorly extends along the base of the peduncular keel midway between the margin of this keel and the mid-ventral line of the body.

Color in spirits, above green, becoming abruptly white on a level with the top of the eye; mid-line of back, edging of dorsal scales and portions of top of head and snout more or less dusky; dorsal, ventrals and upper caudal lobe somewhat dusky, other fins pale.

Type No. 5202, American Museum of Natural History. Carmen Island, April 3, 1 specimen, 15 inches long.

HEMIRHAMPHIDÆ. HALF BEAKS.

Hyporhamphus roberti (*Cuvier and Valenciennes*). COMMON HALF-BEAK.

South end of Magdalena Bay, March 20; Port San Bartholome, March 14; Pichilinque Bay, March 27; Carmen I., April 3; fifteen miles below the head of Concepcion Bay, April 7, and Ceralbo I., April 19. Numerous specimens were taken chiefly with the seine.

Hyporhamphus rosæ (*Jordan and Gilbert*).

Magdalena Bay, March 21, one young specimen seined.

Hemirhamphus balao *Le Sueur.*

San Josef I., March 31, and Ceralbo I., April 20, a single specimen from each of these localities was picked up on the beach. The species is well known and widely distributed in the Atlantic, but has not hitherto been reported from the Pacific Ocean.

EXOCŒTIDÆ. FLYING FISHES.

Fodiator acutus (*Cuvier and Valenciennes*). SHARP-NOSED FLYING-FISH.

Cape San Lucas, March 24, two specimens seined.

FISTULARIIDÆ. TRUMPET FISHES.

Fistularia depressa *Günther.* CORNETA.

Cape San Lucas, March 23; San Josef I., March 31; Agua Verde Bay, April 1, and Santa Catalina I., April 16, taken chiefly in the seine.

SYNGNATHIDÆ. PIPE FISHES.

Siphostoma carinatum *Gilbert.*

East side of Cerros I., March 11, one specimen seined.

Siphostoma leptorhynchum (*Girard*).

One specimen without special data.

Siphostoma exile sp. nov.

Fig. 7.

Head 9; depth 5 in head, equal to breadth; snout 2; eye 3 in postorbital part of head, equal to pectoral, equal to about $\frac{1}{2}$ of caudal. Rings 20 + 45. D. 38, on one and a quarter body rings and eight and three-quarters caudal rings, its base .8 in head, equal to distance from tip to snout to base of pectoral. Body slender, the posterior half of trunk distended, its diameter 3.6 in head; head and trunk in tail 1.4; trunk in tail 1.8. Angles rather low, a low keel on snout not extending on head; no nuchal or opercular ridges.

Color in spirits, pale yellowish; paler on belly, under side of tail with brownish flecks; a conspicuous dark brown band from chin to eye, thence more narrowly

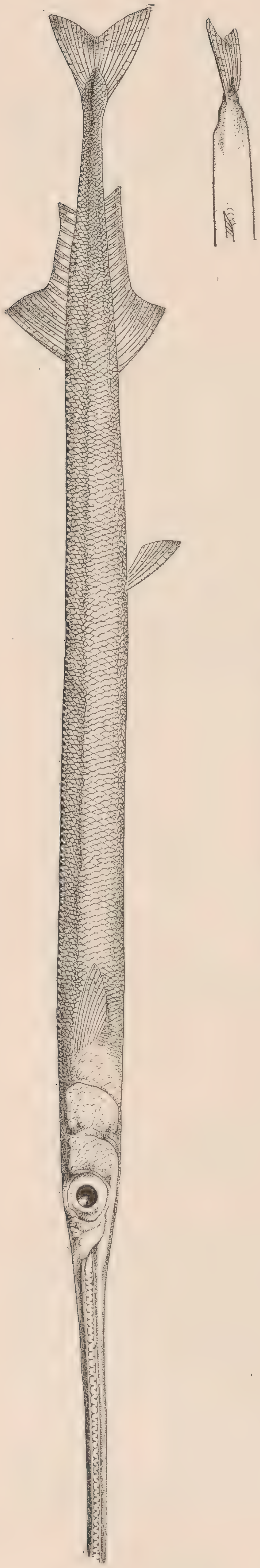

Fig. 6. *Tylosurus plerurus* sp. nov.

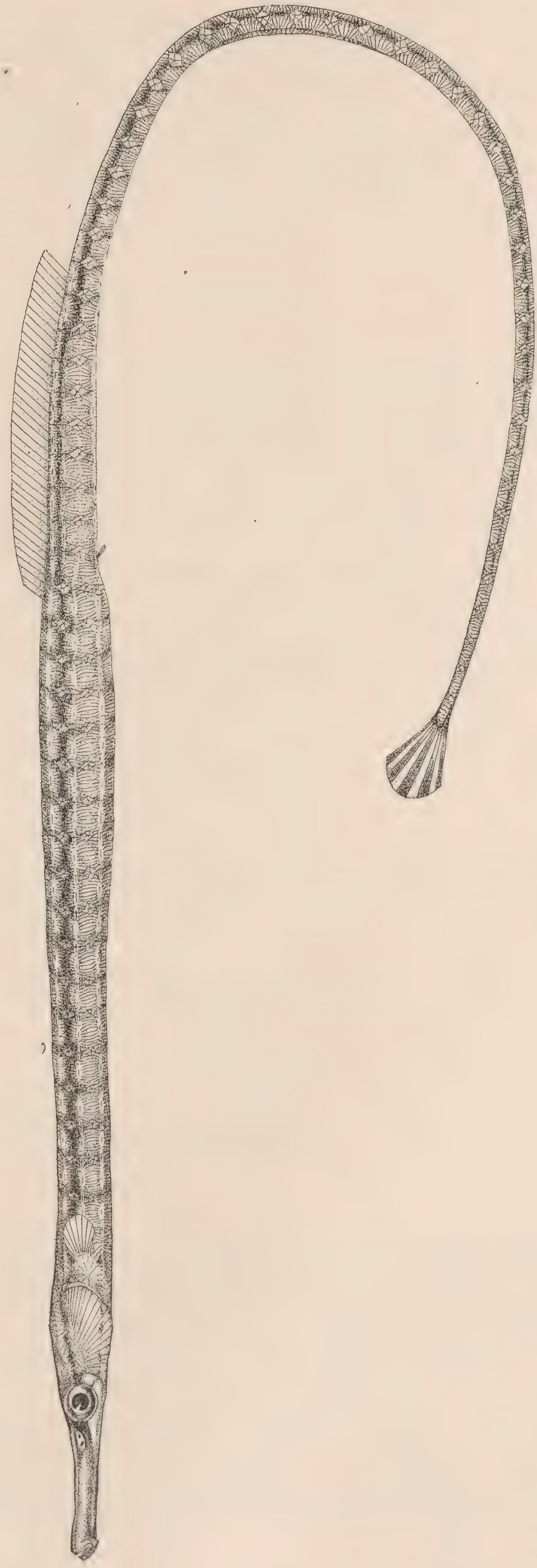

Fig. 7. *Siphostoma exile* sp. nov.

across upper part of opercle, thence backward along the upper part of the side, becoming faint and broken into specks towards caudal. A faint broken streak extends from the eye downward and backward across the lower part of the opercle. Caudal fin dusky, its upper margin whitish.

Type No. 5203 American Museum of Natural History, West San Benito I., March 9, 1911. 1 specimen, total length 6½ inches.

Five smaller specimens, 4 to 4½ inches long were taken at electric light in Port San Bartholome, March 14. The peculiar swollen appearance of the hinder half of the trunk is as evident in these as it is in the type. The dorsal rays in these vary from 35 to 38; the body rings are all 18, the caudal rings vary from 44 to 48. Otherwise there is a close agreement with the type in all structural points. In color, all show the stripe along the side of the snout, the oblique line downward and backward from the eye (which is more distinct than in the type) and the line across the upper part of the opercle. The dark line along the side is not so distinct, but is more or less fused with brownish spots above and below it and broken by lighter irregular cross-bands. The white upper margin of the dusky caudal is more conspicuous than in the type. The largest of these approach the type more nearly than the smaller ones in the matter of coloration.

Hippocampus ingens *Girard.* SEA HORSE.

Head of Concepcion Bay, April 6, one specimen.

Dr. Townsend adds the following note:

"The Sea horse of this region cannot be a common species as only one small living example was taken during the almost daily seining operations of the voyage. Two large dried specimens were found on the beach at Carmen Island, the larger being about ten inches long. The species has been recorded from but few points between San Diego, California and Mazatlan, Mex., the extremities of its known range."

ATHERINIDÆ. SILVER-SIDES.

Leuresthes tenuis (*Ayres*).

Ballenas Bay off Abreojos Point, one specimen six inches long, an adult female with eggs. Although this specimen is from the type locality of *L. crameri* Jordan and Everman, it has the small scales, 74, and the fin formula, D. V. 1, 9; A. 1, 22, of *L. tenuis*. In some measurements, however it agrees more nearly with *L. crameri*, as head 4.8; depth 5.3; eye in snout 1.5, in head 4.3; lateral band 1.2 in eye, covering one row and two half rows of scales. This suggests the probability that *crameri* is a synonym of *tenuis.*

Eurystole eriarcha (*Jordan and Gilbert*).

Cape San Lucas, March 23 and 24, ten specimens taken at the electric light lure, and Santa Catalina I., April 16, one specimen.

Atherinopsis californiensis *Girard.* CALIFORNIA SMELT.

Ballenas Bay, March 16, and Cerros I., March 11, several specimens seined.

Atherinopsis sonoræ sp. nov.

Fig. 8.

Head 4.2; depth 5.8; D. VIII–I, 12; A. I, 22; scales 62–13. Eye 5 in head, snout 3; jaws equal; teeth pointed, in narrow bands, maxillary not reaching eye. Gill rakers long slender and numerous. Scales weakly crenate. Body slender, moderately compressed. Pectoral fin 1, 3 in head, reaching to origin of ventrals which extend ½ distance to vent. Origin of spinous dorsal equidistant between caudal base and preopercle, considerably in advance of origin of anal; origin of soft dorsal about over middle of anal. Caudal widely forked.

Color in spirits; light brown above, silvery below, a plumbeous lateral stripe one fourth the width of the body. Pectorals, dorsals and caudal more or less dusky, ventrals and anal white.

Type No. 5211, American Museum of Natural History, 7½ inches long, S.E. side of Cerros I. March 11, seined. Two smaller specimens 5 and 6 inches long with the same data, have respectively head 4, depth 5.9, scales indeterminate, and head 4.2, depth 5.5, scales about 58.

This species apparently differs from *A. californiensis* in the larger head, lesser depth and much larger scales.

Atherinops insularum *Gilbert.*

Guadalupe I., March 2; San Benito I., March 9, and Cerros I., March 11, numerous specimens.

Atherinops affinis (*Ayres*).

Santa Maria Bay, March 18; Port San Bartholome, March 13 and April 23; Magdalena Bay, March 20 and 21, numerous specimens.

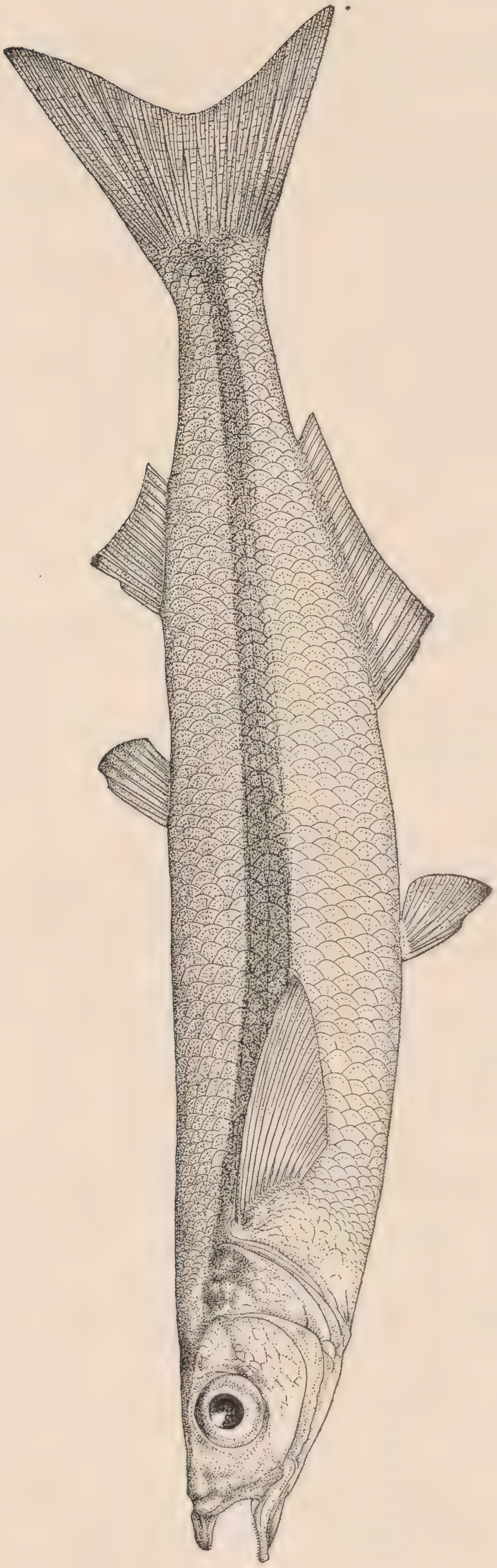

Fig. 8. *Atherinopsis sonoræ* sp. nov.

MUGILIDÆ. MULLETS.

Mugil curema *Cuvier and Valenciennes.* WHITE MULLET.

Magdalena Bay, March 20 and 21; Cape San Lucas, March 24; San Jose del Cabo, March 26; Carmen I., April 3; Mouth of Mulege River, April 4, and head of Concepcion Bay, April 6. Large numbers of various sizes were taken with the seine. At San Jose del Cabo both young and adult were taken in fresh water.

Chænomugil proboscideus (*Günther*).

Cape San Lucas, March 23, one specimen taken at electric light.

SPHYRÆNIDÆ. BARRACUDAS.

Sphyræna argentea *Girard.* CALIFORNIA BARRACUDA.

Cerros I., March 11; Port San Bartholome, March 13; and Agua Verde Bay, April 1, several specimens taken in the seine.

MULLIDÆ. SURMULLETS.

Upeneus xanthogrammus *Gilbert.* GOAT-FISH.

San Josef I., March 31; Pichilinque Bay, April 17, and Ceralbo I., April 20, several specimens.

SCOMBRIDÆ. MACKERELS.

Scomberomorus sierra *Jordan and Starks.* SIERRA.

Agua Verde Bay, April 1, one specimen taken in seine.

NEMATISTIIDÆ.

Nematistius pectoralis *Gill.*

San Josef I., March 31, and Agua Verde Bay, April 1, several specimens taken in the seine.

CARANGIDÆ. POMPANOS.

Oligoplites saurus (*Bloch and Schneider*). LEATHER JACKET.

Mouth of Mulege River, April 4, and fifteen miles below the head of Concepcion Bay, April 7, three specimens seined.

Oligoplites mundus *Jordan and Starks.*

Mulege, April 4, two taken in the seine.

Seriola dorsalis (*Gill*). YELLOW TAIL.

Carmen I., April 3, one specimen seined, and Concepcion Bay off Ricason I., April 7, one specimen.

Trachurus symmetricus *Ayres.*

Guadalupe I., March 3, three specimens taken on a hand-line.

Trachurops crumenophthalmus (*Bloch*). GOGGLE-EYED SCAD.

Carmen I., April 3, two specimens seined.

Caranx hippos (*Linnæus*). JACK.

Mulege, April 4, seined.

Caranx caballus (*Günther*).

Cape San Lucas, March 23, one specimen seined.

Gnathanodon speciosus (*Forskål*).

Carmen I., April 3, two specimens taken in the seine.

Citula dorsalis (*Gill*).

Agua Verde Bay, April 1, one large specimen seined.

Selene vomer (*Linnæus*). LOOK-DOWN OR MOON-FISH.

Mulege, April 4, two specimens seined.

Trachinotus rhodopus *Gill.* POMPANO.

Santa Maria Bay, March 18, one specimen three inches long, seined.

Trachinotus palomo *Jordan and Starks.* POMPANO.

Cerros I., March 11, and Ballenas Bay off Abreojos Point, March 16, several specimens two to three inches long taken in the seine.

CHEILODIPTERIDÆ. CARDINAL FISHES.

Amia retrosella *Gill.* CARDENAL.

San Josef I., March 31; Carmen I., April 3; San Francisquito Bay, April 9; southeast end of Tiburon I., April 11; Santa Cruz and Santa Catalina Is., April 16, and Pichilinque Bay, April 17. Numerous specimens were taken by seining.

Amia guadalupensis sp. nov.

Fig. 9.

Head 2.5; depth 2.9; scales in lateral line 26. D. V–I, 10; A, II, 8. Eye 3.5; snout 4.3; interorbital width 3.8 in head; maxillary 2. Body moderately compressed, dorsal and ventral outlines similar. Caudal peduncle very long, deep and compressed, its least depth $\frac{1}{2}$ the greatest depth of the body. Teeth small, conical, recurved, in narrow bands; anterior teeth in upper jaw somewhat enlarged, teeth present on vomer and palatines. Pectoral fin 1.7 in head, reaching beyond tips of ventrals and not quite to origin of anal; ventral 2; soft dorsal and anal similar, high, somewhat falcate; first dorsal spine the highest and strongest, 2.2 in head, second dorsal 1.7, anal 1.8; caudal emarginate, the lobes blunt, 1.6 in head.

Color in spirits, brownish; caudal dusky, narrowly tipped with pale; central rays of spinous dorsal blackish, contrasting sharply with the rest of the fin; other fins pale. The black center of the spinous dorsal is the only distinctive color mark. It appears to be closely related to *A. atrodorsatus* (Heller and Snodgrass) from the Guadalupe Islands, but differs in color markings of vertical fins and in proportions, and to *A. atricaudus* (Jordan & McGregor) from the west coast of Mexico, from which it differs in the structure and color of the dorsal fin.

Type No. 5204, American Museum of Natural History, Guadalupe Island, March 2, one specimen 4 inches long.

SERRANIDÆ. SEA BASSES.

Petrometopon panamensis (*Steindachner*).

Concepcion Bay, at the head and fifteen miles below the head, on April 5, 6 and 7, nine specimens.

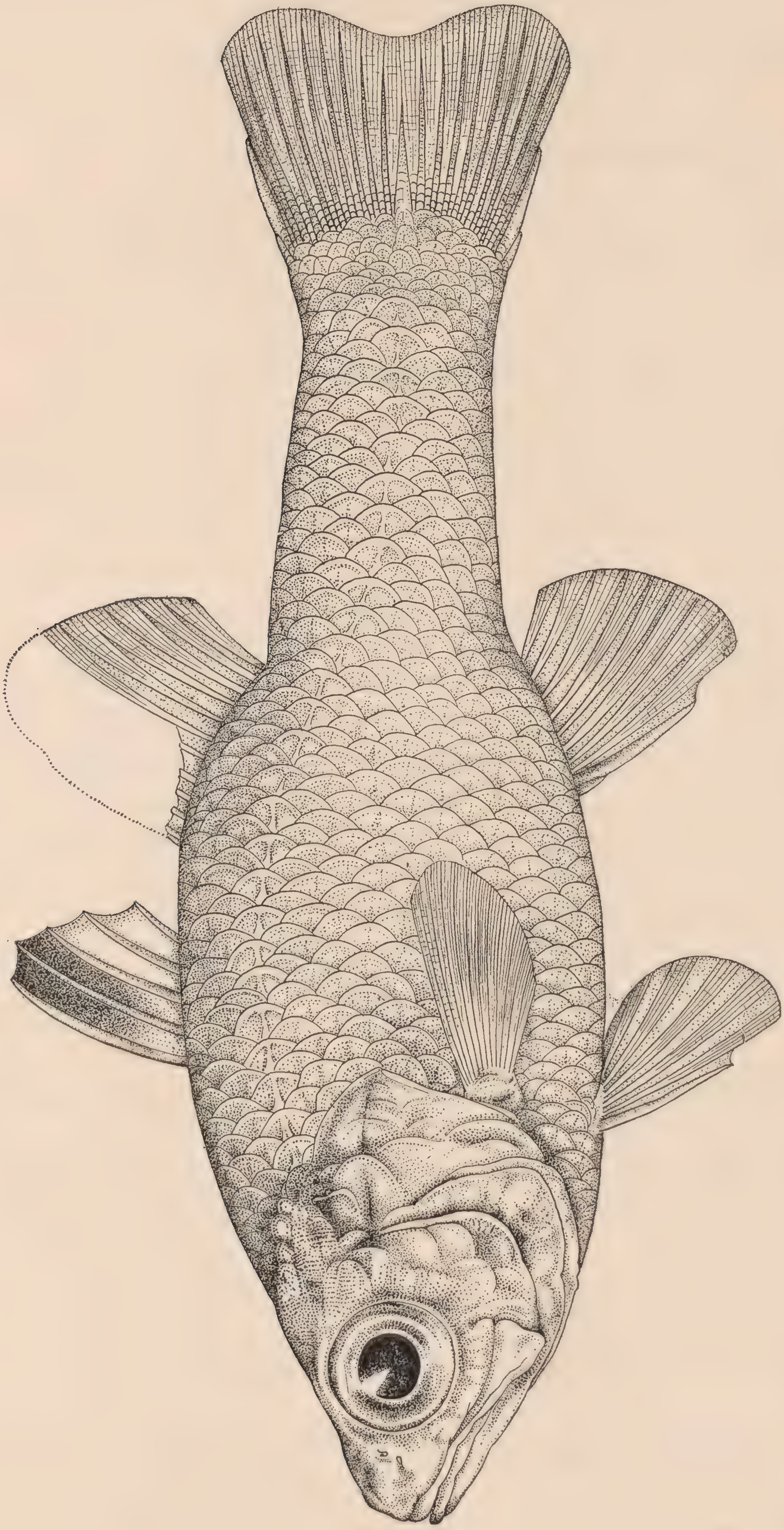

Fig. 9. *Amia guadalupensis* sp. nov.

Dermatolepis punctatus *Gill.*

Santa Catalina I., April 16, one specimen 30 inches long.

Mycteroperca venadorum *Jordan and Starks.*

Angel de la Guardia I., April 16, one specimen about 3 feet long, which contained in its stomach the type specimen of *Bascanichthys bascanoides* sp. nov.

Mycteroperca pardalis *Gilbert.*

San Josef I., March 31; Carmen I., April 3; Concepcion Bay, April 5 and 7; San Francisquito Bay, April 9; Esteban I., April 13, and Ceralbo I., April 19. Numerous specimens of various sizes were taken.

Mycteroperca rosacea (*Streets*).

Angel de la Guardia I., April 10. One adult specimen. Dr. Townsend's color notes on the fresh specimen are, "Plain colored without markings. Graded from orange on the back to light yellow on the belly; the fins, especially the pectorals, similarly graded in color from the upper edge to the lower."

Paralabrax nebulifer (*Girard*). JOHNNY VERDE.

East side of Cerros I., March 11, one specimen on a hand-line.

Paralabrax maculatofasciatus (*Steindachner*). SPOTTED CABRILLA.

Pichilinque Bay, April 17, one specimen. The collection contains three other specimens without data.

Paralabrax clathratus (*Girard*). CABRILLA.

South end of Cerros I., March 12, three specimens.

Diplectrum sciurus *Gilbert.* SQUIRREL-FISH.

Magdalena Bay, March 21, six specimens taken at 13 fathoms in the $3\frac{1}{2}$ ft. Tanner trawl.

Diplectrum radiale (*Quoy and Gaimard*). SQUIRREL-FISH.

Northeast side of Santa Margarita I., March 19, one specimen taken on a hand-line.

Rypticus xanti *Gill.* SOAP-FISH.

Carmen I., April 3, one specimen.

LUTIANIDÆ. SNAPPERS.

Hoplopagrus güntheri *Gill.* PARGO.

San Josef I., March 31; Mulege, April 4, and Concepcion Bay off Ricason I., April 7, several specimens, seined.

Neomænis novemfasciatus (*Gill*). BLACK SNAPPER.

San Jose del Cabo, March 26, numerous specimens taken in fresh water, and Agua Verde Bay, April 2.

Neomænis argentiventris (*Peters*). YELLOW SNAPPER.

Concepcion Bay off Ricason I., April 8, and Pichilinque Bay, April 17, several specimens.

Neomænis colorado (*Jordan and Gilbert*). MAZATLAN RED SNAPPER.

Mulege, at the mouth of the river, one specimen, seined.

Xenistius californiensis (*Steindachner*).

Cerros I., March 11, and Port San Bartholome, March 13, several specimens seined.

HÆMULIDÆ. GRUNTS.

Hæmulon sexfasciatum *Gill.*

San Josef I., March 31, Carmen I., April 3, and Pichilinque Bay, April 17, several specimens seined.

Hæmulon steindachneri (*Jordan and Gilbert*).

Pichilinque Bay, March 28, one taken on a hand-line.

Lythrulon flaviguttatum (*Gill*).

Southeast end of Tiburon I., April 12, a dozen young specimens, and Esteban I., April 13, one specimen.

Anisotremus interruptus (*Gill*).

San Josef I., March 31; Esteban I., April 13, and Port San Bartholome, April 23, several specimens seined. These approach *A. surinamensis* somewhat more closely than the type description of *interruptus* does.

Anisotremus davidsoni (*Steindachner*).

Port San Bartholome, April 23, two specimens seined.

Brachydeuterus leuciscus (*Günther*). BURRITO.

Mulege, at mouth of river, April 4, two specimens seined.

Isaciella brevipinnis (*Steindachner*).

Carmen I., April 3, one specimen.

SPARIDÆ. PORGIES.

Calamus brachysomus (*Lockington*).

Pichilinque Bay, March 28, one taken on a hand-line, and Concepcion Bay off Ricason I., April 7, several specimens.

GERRIDÆ.

Eucinostomus californiensis (*Gill*).

Port San Bartholome, March 14 and April 23; Magdalena Bay, March 20 and 21; San Jose del Cabo, March 25; Agua Verde Bay, April 1; Carmen I., April 3; Mulege, at mouth of river, April 4; Concepcion Bay, April 5 to 7. Apparently this is a very abundant species throughout the region as numerous specimens were taken at most of the above localities. At San Jose del Cabo they were taken in fresh water.

Xystæma cinereum (*Walbaum*). BROAD SHAD.

Magdalena Bay, March 21; San Jose del Cabo, March 26; Agua Verde Bay, April 1 and 2; Carmen I., April 3; Concepcion Bay, April 6 and 7, and Tiburon I., April 11. This species occurred with the preceding, in most of its range, but apparently is not so abundant. The specimens from San Jose del Cabo were taken in fresh water.

Gerres peruvianus (*Cuvier and Vallenciennes*).

Mulege, at mouth of river, April 4, two specimens seined.

Gerres lineatus (*Humboldt*).

Mulege, April 4, two specimens seined.

KYPHOSIDÆ.

Girella nigricans (*Ayres*). GREEN FISH.

Guadalupe I., March 2; San Benito I., March 9, and Cerros I., March 11, young and adults seined.

Girella simplicidens sp. nov.

Fig. 10.

Head 3.6; depth 2.1. D. XIV, 14; A. III, 12. Scales finely ctenoid; downward and forward from front of soft dorsal to lateral line 7, upward and forward from front of anal to lateral line 15, lateral line 50. Body deep, compressed, upper and lower outlines similar, strongly arched. Eye 5; snout 2.5; interorbital width 3; maxillary 2.8; preorbital equal to eye; preopercle finely serrate. Mouth sub-inferior, transverse, its width 2.6 in head; lips fleshy; premaxillary protractile and very broad, 1.5 in eye; teeth moveable, two to four front rows of simple incisiform teeth, with bands of minute teeth behind these. Gill rakers moderately long, slender, close set and numerous. Pectoral broad, 1.1 in head; ventrals short, not reaching vent, 1.3 in head; dorsal low, not emarginate, the longest spine 2.2, longest ray 2; anal spines rather stout, graduated, the third 2.5; longest ray 1.7; caudal lunate.

Color in spirits, uniformly dark with obscure, darker lengthwise stripes indicated by spots at the centers of the scales.

Type No. 5209, American Museum of Natural History, from San Francisquito Bay, April 8, 9½ inches long.

Besides the type we have two larger specimens, one 13 in. long from Tiburon I., April 11 and one 15 in. long from the type locality, April 8, and one smaller specimen 8 in. long from the east side of Esteban I., April 13.

In the 13 inch specimen the teeth resemble those of the type except for the presence of a small blunt cusp more or less basally situated on each side. The largest specimen has a few such cusped teeth, the greater number being simple like those of the two smaller specimens. Even when the lateral cusps of these teeth are best developed they are still strongly contrasted with those of *G. nigricans* which are trident with the three cusps nearly equally developed.

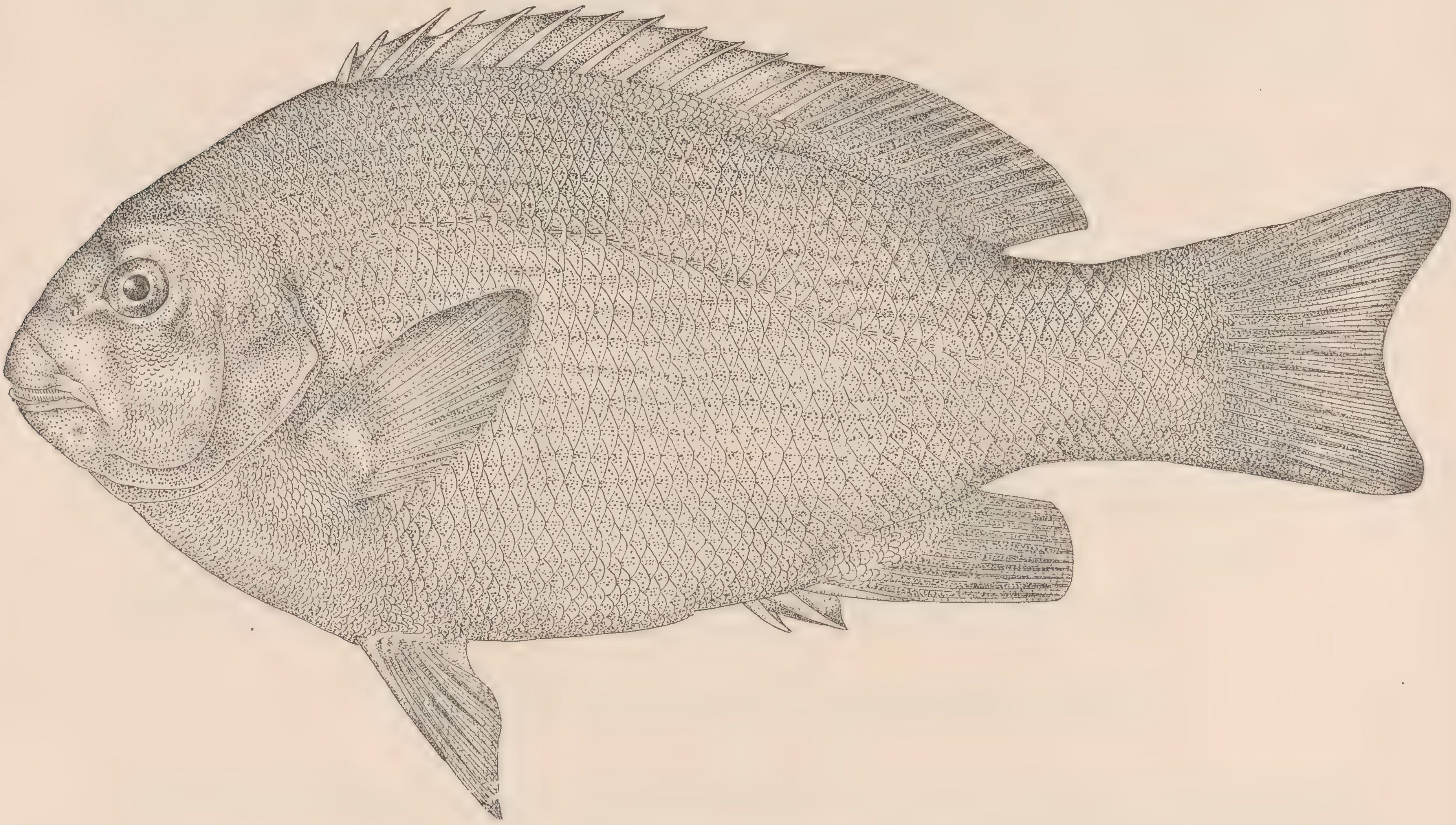

Fig. 10. *Girella simplicidens* sp. nov.

Our specimens are still further distinguished from those of *G. nigricans* in the collection by the shorter, deeper body.

Hermosilla azurea *Jenkins and Evermann.*

Cerros I., March 11, four specimens, and Port San Bartholome, April 23, one specimen, seined.

Hermosilla robusta sp. nov.

Fig. 11.

Head 3.7; depth 2; eye 5 in head. D. XI, 10; A. III, 10; scales 9, 52, 19. Body deep, robust; dorsal and ventral outlines rounded, similar. Snout 3; interorbital 2.4; maxillary not quite reaching front of eye, 3.5 in head; preorbital 1.5 in eye. Gill rakers short and stout, about 12 on lower limb of arch, 3 in eye. Dorsal and anal fins each with a basal sheath of scales; soft fins densely scaled. Second anal spine longest, 3.8 in head, longer and stouter than the first and third which are about 4.7 in head; when depressed the second spine reaches about to the tip of the third. Ventrals 1.5 in head, reaching slightly more than half way to the origin of the anal.

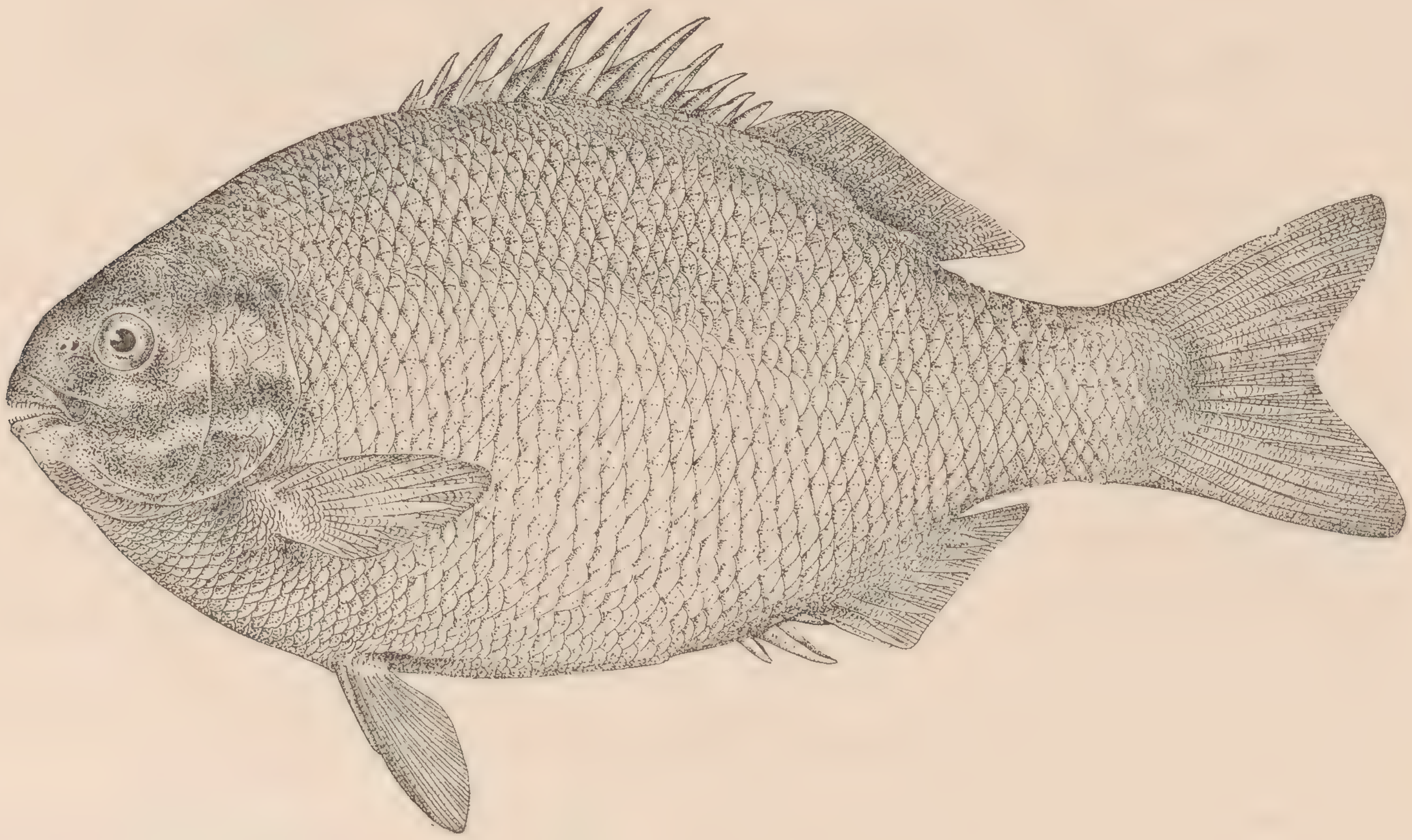

Fig. 11. *Hermosilla robusta* sp. nov.

Color in spirits dusky, somewhat paler below, lacking the cross bands of *azurea;* the fins all dusky; a silvery stripe below eye extending backward on opercle; an intense black blotch in axil of pectoral; the black mark at angle of opercle narrower than in *azurea.*

Type No. 5210, American Museum of Natural History, Tiburon I., April 12, 15 inches long.

Besides the type we have another specimen 14 inches long from Carmen I., April 3, which agrees with it in all essentials. The two differ notably from specimens of *H. azurea,* from the places listed under that species, in the following points; noticeably greater depth in specimens of the same length; the stouter gill rakers; ventral fins not extending so far backward, and the absence of vertical bars on the body.

Kyphosus analogus (*Gill*).

San Josef I., March 31; Carmen I., April 3; Mulege, April 4; Tiburon I., April 11, and Santa Catalina I., April 16, a number of specimens seined.

SCIÆNIDÆ. CROAKERS.

Seriphus politus *Ayres.* QUEEN-FISH.

Port San Bartholome, March 13, one specimen two and a half inches long taken in the seine.

Umbrina roncador *Jordan and Gilbert.* YELLOW-FINNED RONCADOR.

Port San Bartholome, April 23, two specimens seined.

Umbrina xanti *Gill.*

South end of Magdalena Bay, March 20; Mulege River at its mouth, April 4, and Concepcion Bay, April 6, several specimens seined.

Menticirrhus undulatus (*Girard*). CALIFORNIA WHITING.

Ballenas Bay at Abreojos Point, March 16, a dozen specimens seined.

Eques viola *Gilbert.*

San Josef I., March 31; Carmen I., April 3, and Concepcion Bay at various points, April 6 to 8. Seven specimens in all.

EMBIOTOCIDÆ. SURF-FISHES.

Brachyistius frenatus (*Gill*).

Guadalupe I., March 2, a half dozen specimens.

Embiotoca jacksoni *Agassiz.* COMMON SURF-FISH.

San Benito I., March 9, and north and east sides of Cerros I., March 11, several specimens seined.

POMACENTRIDÆ. DEMOISELLES.

Chromis atrilobatus *Gill.*

Santa Catalina I., April 16, one specimen.

Chromis punctipinnis (*Cooper*). BLACKSMITH.

Guadalupe I., March 2, four specimens.

Eupomacentrus rectifrænum (*Gill*).

San Josef I., March 31; Carmen I., April 3; Concepcion Bay, April 4 and 5; San Francisquito Bay, April 9; Tiburon I., April 11; San Esteban I., April 13; Santa Cruz I., April 16; Santa Catalina I., April 16, and Pichilinque Bay, April 17. Many specimens were taken by various methods.

Abudefduf saxatilis (*Linnæus*). SERGEANT MAJOR.

San Josef I., March 31; Carmen I., April 3; Mulege, April 4, and Concepcion Bay, April 7, a number of specimens.

Hypsypops rubicundus (*Girard*). GARABALDI.

Guadalupe I., March 2, eight specimens.

LABRIDÆ. WRASSES.

Harpe diplotænia *Gill.*

Ceralbo I., April 19, two specimens.

Pimelometopon pulcher (*Ayres*). FAT-HEAD.

Ceralbo I., April 19, two specimens.

Iridio semicinctus (*Ayres*). KELP-FISH.

Southeast part of Tiburon I., April 11, one specimen.

Iridio dispilus (*Günther*).

Head of Concepcion Bay, April 5, one specimen.

Oxyjulis californicus (*Günther*).

North end of Cerros I., March 11, one specimen seined.

Emmeekia venusta (*Jenkins and Evermann*).

Cerros I., off the northern and the southeastern shores, March 11 and 12, two specimens taken in the $3\frac{1}{2}$ ft. Tanner trawl; southeast end of Tiburon I., April 11 and 12, two specimens.

SCARIDÆ. PARROT FISHES.

Callyodon perrico (*Jordan and Gilbert*).

San Josef I., March 31, one large specimen.

Callyodon microps sp. nov.

Fig. 12.

Head 2.8; the body robust, deep and compressed, depth 2.3. A conspicuous fleshy hump at the nape, extending from before the eyes to the insertion of the dorsal fin. Snout 2; preorbital 3.8; maxillary 3.2; eye very small, 11 in head, 5.5 in snout. Teeth green; no posterior canines; upper lip covering two thirds of the tooth base, the lower about two fifths. Two rows of scales on the cheek, five scales in each row. Gill membranes united, free from the isthmus.

Scales moderate, $2\frac{1}{2}$, 23, $6\frac{1}{2}$; lateral line complete.

Dorsal X, 9, beginning over the insertion of the pectoral, the posterior rays highest, the longest 2.5 in head; pectoral bluntly falcate, 1.5 in head; ventrals pointed, 1.8 in head, reaching three fifths of the distance to the vent; anal II, 9, its longest ray 3.3 in head; caudal lunate, its angles strongly exserted, the lobes extending for a distance equal to 2.75 in the snout. Caudal peduncle short and deep, its depth 2.5 in head.

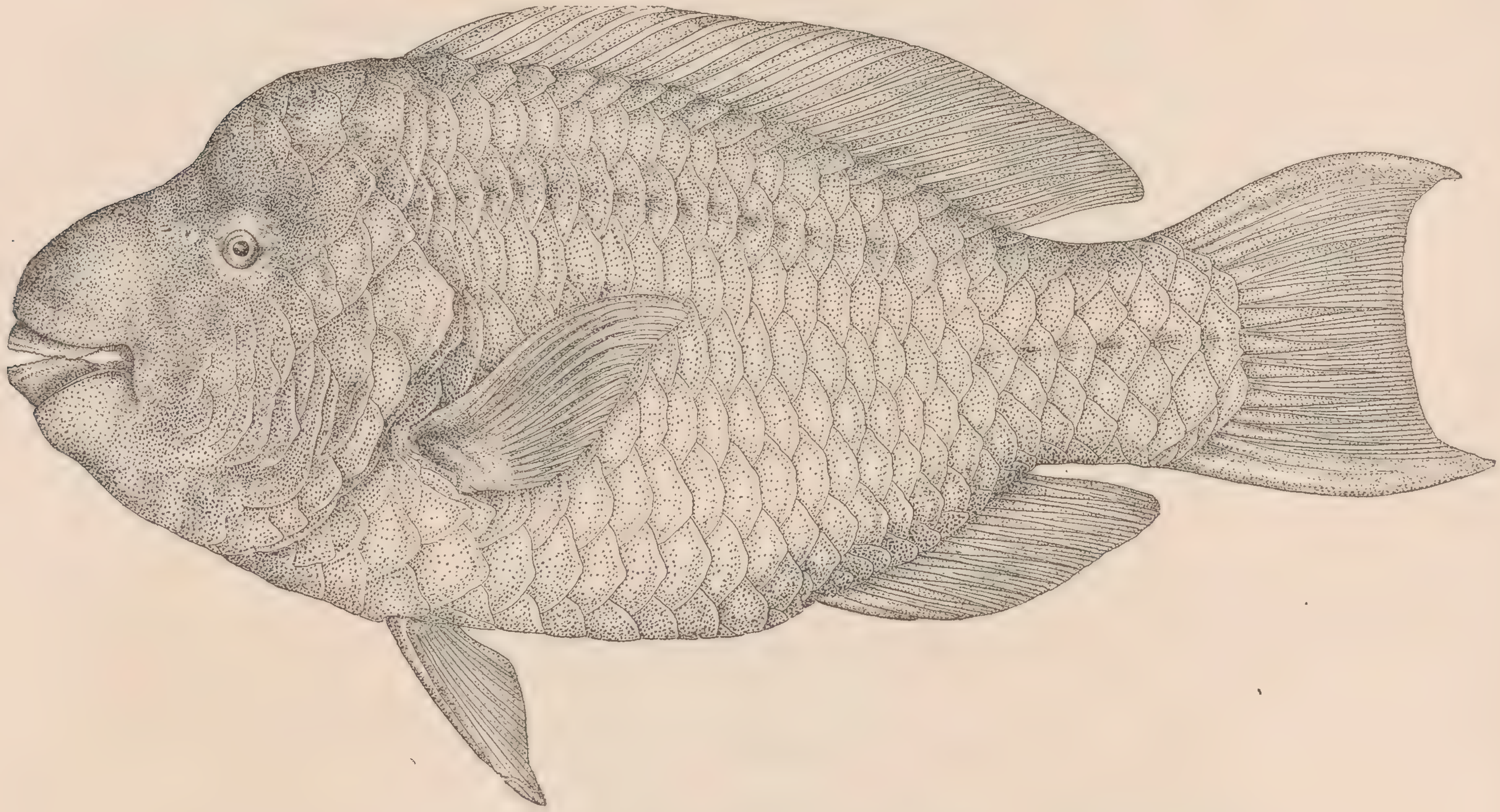

Fig. 12. *Callyodon microps* sp. nov.

Color in spirits everywhere, including the fins, dark olive green; the fins with more or less dusky, especially so on the middle rays of the caudal.

Type No. 5212, American Museum of Natural History. One specimen 28 inches long, from Santa Catalina I., April 16, 1915.

Like *C. perrico,* but differs in the exserted caudal lobes, the much smaller eye, and minor points.

Callyodon noyesi (*Heller and Snodgrass*).

This species has hitherto been known from the Galapagos Is., from which place it was described in 1903. Kendall and Radcliffe in 1912 listed it "probably from Perico Island or Panama." In the present collection it appears from two localities, San Josef I., Mch. 31, 1911, one specimen 23 inches long, and Concepcion Bay, off Ricason I., three specimens of about the same size. Although these specimens differ from the description somewhat in proportions and coloration, the differences hardly warrant their separation as a distinct species. The description of the San Josef specimen is as follows:

Body compressed, elliptical, dorsal and ventral outlines similar, depth 2.7. Head large, rather pointed, 3 in body. Eye small, 3.4 in snout, 2.5 in preorbital. Snout 2.4 in head. Gape of mouth 4.5 in head. Teeth whitish, the tessellation evident; central suture prominent; posterior canines moderate, 2 on one side and 2 and a rudiment on the other. Scales on cheek in two and a half rows. Scales of body 2½, 25, 6½; six before dorsal. Dorsal IX, 10; the highest spine 2.9 in head, the highest ray 2.6. Anal II, 9, increasing slightly in height posteriorly, the longest ray 3 in head. Pectoral narrowly rounded, 1.4 in head. Ventrals pointed, nearly 2 in head, reaching a little more than half way to vent. Caudal peduncle long and rather slender, 2.4 in head. Caudal fin with nearly straight hind margin, but its angles much exserted and pointed, projecting a distance equal to .4 of the head beyond the median portion of the fin.

Color in spirits, uniform yellowish white, except for a faint indication of lengthwise stripes on the sides below and dusky marks about the lower jaw; central rays of caudal very narrowly tipped with dusky.

The following color notes in life were made by Dr. Chas. H. Townsend when the specimen was taken: Pale cream or milky white color, with all markings in pale light blue. Blotches around orbit; fins, except ventrals, all bordered (only the upper edge of the pectoral so marked), a spot at the base of the caudal, and about five striped on the side, all of this color.

Callyodon compressus sp. nov.

Fig. 13.

Body much compressed, deep, 2.5 in length, lower outline more arched than upper. Head 3, moderately pointed, slightly humped over the eyes. Eye 3.7 in snout, 8.5 in head, 2.2 in preorbital, vertical distance above eye one half that from eye downward. Gape of mouth 4 in head. Snout 2.3. No canine teeth present. Scales on cheek in two and a half rows, 6, 5, 2, those of the upper row somewhat larger. Scales of body 2½, 25, 6½; six before dorsal.

Dorsal IX, 10, about even throughout its length, highest spine 2.4 in head, longest ray 2.6. Anal II, 9, longest ray 2.5 in head. Pectoral pointed, extending beyond tips of ventrals, 1.4 in head. Ventrals 1.6 in head, extending more than half way to vent. Caudal weakly lunate, its outer rays scarcely exserted. Caudal peduncle deep and compressed, its least depth 2 in head.

Color in alcohol, brownish, slightly darker along back; dorsal, caudal and anal fins dusky, the anal with a lighter margin. Paired fins pale. Teeth whitish, with indications of rosy toward the base.

Type No. 5205, American Museum of Natural History.

Concepcion Bay off Ricason Pt., April 7, 1911. Only the type specimen taken, total length 19 inches.

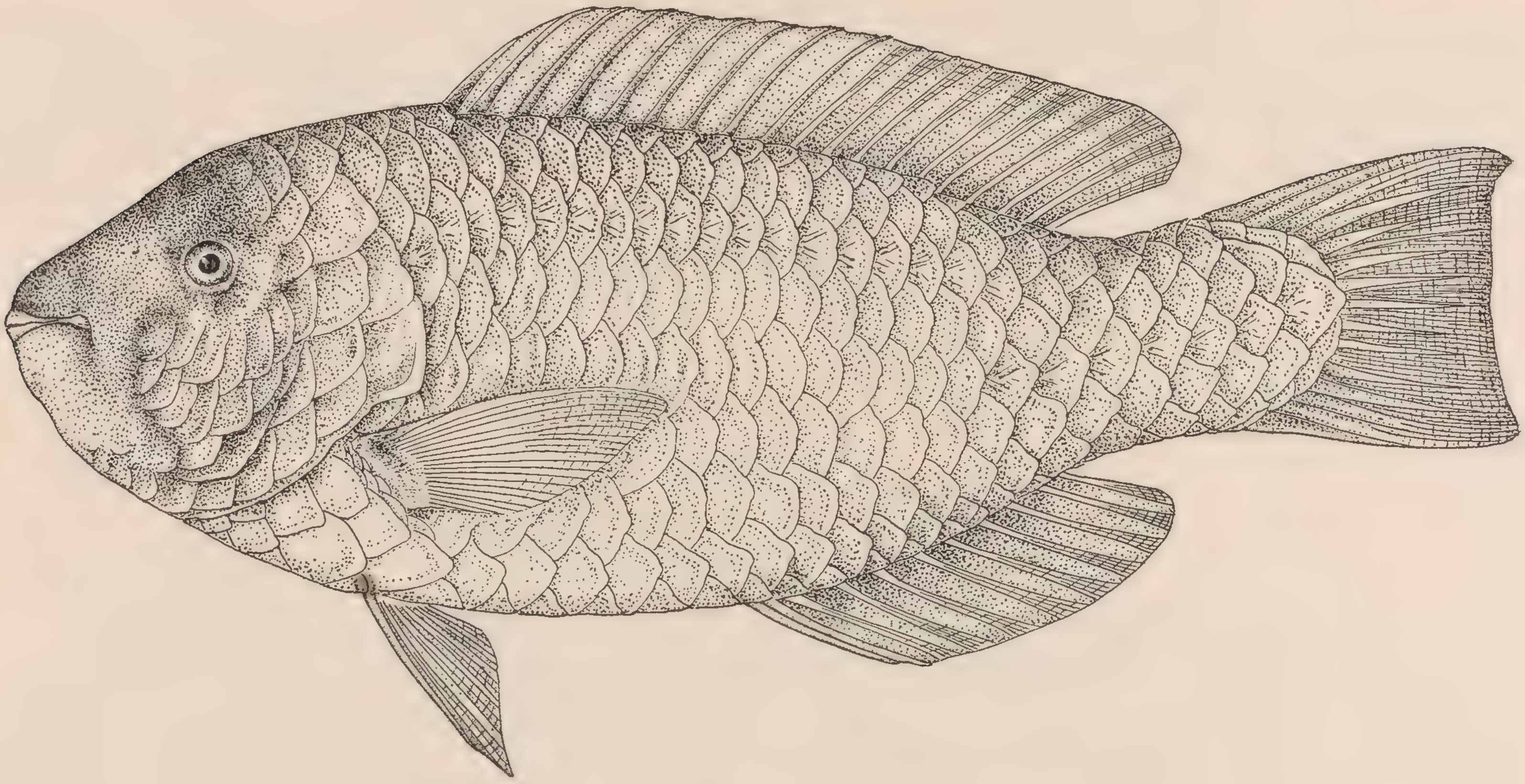

Fig. 13. *Callyodon compressus* sp. nov.

EPHIPPIDÆ. SPADE FISHES.

Chætodipterus zonatus (*Girard*). SPADE-FISH.

Santa Maria Bay, March 18, two young specimens seined.

CHÆTODONTIDÆ. BUTTERFLY FISHES.

Holocanthus passer *Valenciennes.*

Santa Cruz I., April 16, a single specimen.

TEUTHIDIDÆ. SURGEON FISHES, TANGS.

Xesurus punctatus (*Gill*).

Santa Catalina I., April 16, two specimens, each about 18 inches long.

BALISTIDÆ. TRIGGER FISHES.

Balistes polylepis *Steindachner.*

Pichilinque Bay, March 27; Carmen I., April 3; Concepcion Bay off Ricason I., and also at the head of the Bay, April 6; Angel de la Guardia I., April 10; Tiburon I., April 11. Specimens ranging in size from 7 to 18 inches were taken, on hand-lines, and by other methods.

Pachynathus capistratus (*Shaw*).

San Josef I., March 31; Santa Catalina I., April 16; Pichilinque Bay, April 17, and Ceralbo I., April 20, one or two specimens taken at each of these localities.

TETRAODONTIDÆ. SWELL FISHES.

Sphæroides lobatus (*Steindachner*).

Cape San Lucas, March 23, one young specimen 3½ inches long.

Sphæroides annulatus (*Jenyns*).

Port San Bartholome, March 13 and April 23; Santa Maria Bay, March 18; Magdalena Bay, March 20; Pichilinque Bay, March 27; Agua Verde Bay, April 1; Concepcion Bay, April 7, and Tiburon I., April 11. One to several specimens taken at each locality, mostly by seining, but one was taken on a hand-line. Two specimens from San Bartholome have the small spots of the variety *politus*.

Ovoides setosus (*Rosa Smith*).

Cape San Lucas, March 23, three specimens seined, and Ceralbo I., April 20. Two of the specimens from Cape San Lucas were blue-black in color, with rounded yellow spots, while the third was black with vermiculations of yellow. The Ceralbo specimen was yellowish all over except for a black bar across the pectoral and dorsal. All were approximately of the same size.

DIODONTIDÆ. PORCUPINE FISHES.

Diodon hystrix *Linnæus*. PORCUPINE FISH.

Cape San Lucas, March 23 and 24; San Josef I., March 31; Agua Verde Bay, April 1; Carmen I., April 3, and Espiritu Santo, April 20, one or more specimens at each place. At Espiritu Santo they are injurious to the pearl oysters.

The color markings on these specimens intergraded from *D. hystrix* to *D. holocanthus*, and in some of them the frontal spines were larger than the post-pectoral, after the manner of *D. holocanthus.* Jordan and Evermann (Fishes of North and Middle America, Bull. 47, U. S. Nat. Mus., pp. 1745–6) suggest that these supposed species may be identical. The Lower California specimens support this hypothesis.

SCORPÆNIDÆ.

Sebastopsis xyris *Jordan and Gilbert.*

Carmen I., April 3; San Francisquito Bay, April 9; southeast end of Tiburon I., April 11; Esteban I., April 13; Santa Catalina I., April 16. Numerous specimens, ranging in size from a half inch in length to adult, were taken by seining.

Scorpæna guttata *Girard.* SCORPION-FISH.

Guadalupe I., March 4; Cerros I., March 12; Port San Bartholome, March 13, and Esteban I., April 12, a single specimen at each locality, taken in the seine.

Scorpæna mystes *Jordan and Starks.* SCORPION-FISH.

Pichilinque Bay, March 27, one taken at the electric light lure, and Carmen I., April 4, one taken in the seine.

Scorpæna sonoræ *Jenkins and Evermann.* SCORPION-FISH.

Santa Maria Bay, March 18; Magdalena Bay, March 21, and Agua Verde Bay, April 1. At Magdalena Bay one specimen was taken at 13 fathoms in the Tanner Trawl; those from the other stations were seined.

COTTIDÆ. SCULPINS.

Icelinus quadriseriatus (*Lockington*).

Cerros I., March 12, and Port San Bartholome, March 13, a single specimen taken at each place by means of the boat (3½ ft. Tanner) dredge, in shallow water.

Clinocottus analis (*Girard*).

San Benito I., March 9, one specimen seined.

GOBIIDÆ. GOBIES.

Philypnus lateralis *Gill.*

San Jose del Cabo, March 26, a dozen specimens seined in fresh water.

Dormitator maculatus (*Bloch*).

San Jose del Cabo, March 26, one specimen, and Agua Verde Bay, April 2, several dozen specimens, ranging in size from one half to four inches long. All were taken by the seine in fresh water.

Eleotris pictus (*Kner and Steindachner*).

San Jose del Cabo, March 25, three specimens seined in fresh water.

Gobius saggitula (*Günther*).

Agua Verde Bay, April 2, six specimens seined.

Awaous taiasica (*Lichtenstein*).

San Jose del Cabo, March 26, a dozen specimens seined in fresh water.

Zalypnus emblematicus (*Jordan and Gilbert*).

San Josef I., March 31, one specimen, one and a half inches long.

Gobiosoma histrio *Jordan.*

San Francisquito Bay, April 9, one specimen.

Gobiosoma crescentale *Gilbert.*

Agua Verde Bay, April 11, two specimens, one and a half inches long, taken in the seine. Hitherto the species has been known only from the type specimen.

MALACANTHIDÆ.

Caulolatilus princeps (*Jenyns*).

Guadalupe I., March 2, one specimen, and Cerros I., March 10, three specimens, all taken on hand-lines.

DACTYLOSCOPIDÆ. SAND STAR-GAZERS.

Gillellus arenicola *Gilbert.*

Cape San Lucas, March 23, two specimens, about one and a half inches long, taken in the seine.

Dactyloscopus lunaticus *Gilbert.*

Cape San Lucas, March 23, a dozen specimens, and San Josef I., March 31, one taken. All were captured in the seine.

Dactyloscopus cinctus, sp. nov.

Fig. 14.

Head 4; depth 6; D. about 43, spines weak, indistinguishable from rays; A. II, 33. Body compressed, tapering rather evenly backward from the insertion of the pectorals. Head cuboid behind the eyes, abruptly conical in front, the profile straight, top of head flat. Eye slightly longer than snout, 5.5 in head. Snout 6. Maxillary reaching posterior edge of pupil, 3.5 in head. Interorbital width half the diameter of the eye. Opercle fringed with about 20 teeth, the upper six or seven rather deeply incised.

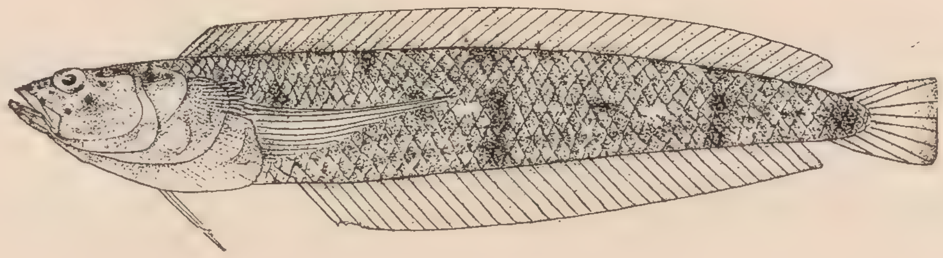

Fig. 14. *Dactyloscopus cinctus* sp. nov.

Dorsal continuous, beginning just behind nape and well in front of anal origin. Pectoral pointed, equal to head. Ventrals a little less than one half the head. Caudal a little more than one third of the head.

Scales 53. Anterior portion of lateral line running up close to base of the dorsal fin, thence descending abruptly over three rows of scales and continuing posteriorly on the middle of the side; anterior portion contained three and a third times in the posterior portion.

Color in alcohol, faintly purplish gray, more or less straw-colored about the head. A conspicuous purplish black cross-bar at about the middle of the body, interrupted on the upper part of the side; a similar bar about half way between this and base of caudal, and a short bar across the upper part of the side just behind the head; a dark blotch at base of caudal; dark linear spots on middle line of side at intermediate points; a linear pearly white spot on midline of side on either side of median and posterior cross-band; a pearly white blotch on opercle and a line of the same color downward from eye; a series of dark spots on mid-dorsal line and small dots on the upper side of the head.

Type No. 5206, American Museum of Natural History, Cape San Lucas, March 23, 1911, length 1.3 inches, taken in seining. Two other specimens about the same size and corresponding remarkably well in color were taken at the same time.

Dactylagnus mundus *Gill.*

South end of Magdalena Bay, March 20, one specimen seined.

Myxodagnus opercularis *Gill.*

Cape San Lucas, March 23, two specimens, one $1\frac{1}{4}$ inches, the other $1\frac{3}{4}$ inches in length, both taken in the seine.

URANOSCOPIDÆ. STAR-GAZERS.

Astroscopus zephyreus *Gilbert and Starks.*

Ballenas Bay, March 16, one specimen 8 inches long taken in the seine. Only two specimens hitherto known.

BATRACHOIDIDÆ. TOAD-FISHES.

Porichthys notatus *Girard.* MIDSHIPMAN.

San Bartholome Bay, March 13; Santa Maria Bay, March 18, and Magdalena Bay, March 21. Specimens were seined at all three places, and one was taken at 13 fathoms by the trawl at Magdalena Bay.

GOBIESOCIDÆ. CLING-FISHES.

Gobiesox adustus *Jordan and Gilbert.*

San Francisquito Bay, April 9, one specimen.

Gobiesox funebris *Gilbert.*

San Francisquito Bay, April 9, numerous specimens taken at the shore.

Arbaciosa humeralis (*Gilbert*).

San Francisquito Bay, April 9, a dozen specimens taken at the shore.

Arbaciosa eos (*Jordan and Gilbert*).

San Francisquito Bay, April 9, two specimens, and Angel de la Guardia I., April 11, ten specimens, taken at the edge of the shore.

BLENNIIDÆ. BLENNIES.

Gibbonsia elegans (*Cooper*). SPOTTED KELP-FISH.

South end of Cerros I., March 12; two specimens.

? **Malacoctenus delalandi** (*Cuvier and Vallenciennes*).

San Benito I., March 9, one specimen an inch long, apparently belongs to this species.

Labrisomus xanti *Gill.*

Port San Bartholome, March 14; south end of Magdalena Bay, March 20, and Cape San Lucas, March 24, taken with the seine. Those from Cape San Lucas were only about an inch in length.

Exerpes asper (*Jenkins and Evermann*).

Pichilinque Bay, March 27, two specimens taken at the electric light lure.

Runula azalea *Jordan and Bollman.*

Cape San Lucas, on the evenings of March 23 and 24, when a couple of dozens of specimens were taken about the electric light lure.

Hypsoblennius gentilis (*Girard*).

Port San Bartholome, March 14, and Concepcion Bay, April 7, about a dozen specimens in all were taken with the seine.

Emblemaria oculocirris *Jordan.*

San Josef I., March 31, one specimen.

Lucioblennius alepidotus *Gilbert.*

Cape San Lucas, March 23; three specimens seined, and Carmen I., April 3, one specimen taken in shallow water with the 3½ ft. Tanner trawl.

Our specimens range in size from one to two inches, and are more elongate than the description, the head varying from 3.5 to 4, instead of 3.25. Hitherto only two specimens have been known.

Lucioblennius lucius sp. nov.

Fig. 15.

Head 3; depth 4 in head; body elongate compressed throughout; the head flat above, broader and deeper than the body; jaws pike-like, elongate, depressed and broadly rounded in front. Eyes placed high, close together, 6 in head. Mouth wide, maxillary 1.9 in head, extending well beyond the posterior border of the eye; snout 3.5; lower jaw slightly projecting; teeth rather strong, in narrow bands, a single series on the sides of the lower jaw, a few teeth on the vomer. Body scaleless.

Ventral fins 2.3 in head, composed of one spine and two soft rays, inserted slightly in front of the pectorals which they equal in length. Dorsal about 50, anal about 35, both fins continuous and rather low, the rays and spines not well differentiated; dorsal beginning on nape over the anterior part of the opercle, the anterior spines the longest, about equal to eye; anal origin nearer base of caudal than tip of snout; caudal short.

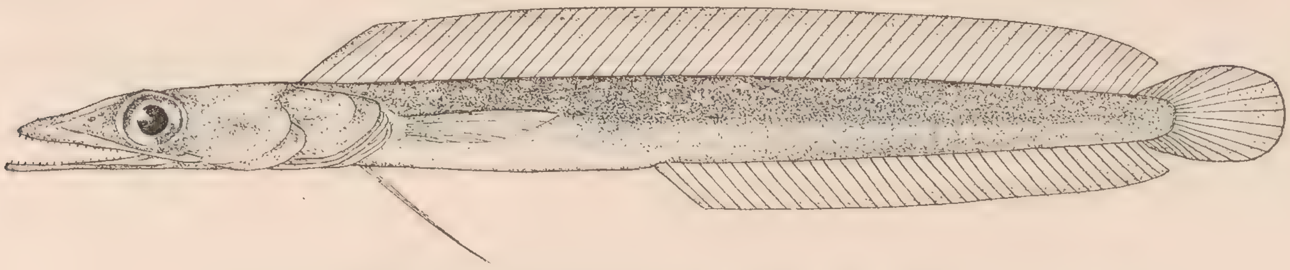

Fig. 15. *Lucioblennius lucius* sp. nov.

Color in alcohol, pale olive; a row of small distinct, pearly white specks along upper part of side, each speck connected with its fellow of the opposite side across the back by one or two less distinct specks; other pearly white dots on the side and the lower half of the head of the same color. Anterior part of dorsal fin with a few blackish markings.

Type No. 5207, American Museum of Natural History, 1.5 inches long, San Josef Island, March 31, 1911. Another similar specimen of about the same size taken with the type.

Ulvicola sanctæ-rosæ *Gilbert and Starks.*

Guadalupe I., March 3, two specimens.

OPHIDIIDÆ. CUSK EELS.

?**Otophidium galeoides** (*Gilbert*).

Cape San Lucas, March 23, one mutilated specimen, the head only preserved.

BROTULIDÆ.

Ogilbia ventralis (*Gill*).

Carmen I., April 3, and at the head of Concepcion Bay, April 6, four specimens in all.

PLEURONECTIDÆ. FLOUNDERS.

Hippoglossina macrops *Steindachner.*

Cerros I., March 12, one young specimen taken in the 3½ ft. Tanner trawl.

Paralichthys californicus (*Ayres*). BASTARD HALIBUT.

Port San Bartholome, March 14, and again on April 23; Ballenas Bay, March 16, and Magdalena Bay, March 20. Numerous specimens were seined, of which only two were sinistral, one from Ballenas Bay and one from Magdalena Bay.

Pleuronichthys verticalis *Jordan and Gilbert.*

Cerros I., March 11; Port San Bartholome, March 13; and Magdalena Bay, March 21, a single specimen from each locality. At Magdalena Bay the specimen was dredged in 13 fathoms.

Hypsopsetta guttulata (*Girard*). DIAMOND FLOUNDER.

Port San Bartholome, March 13 and 14, and Ballenas Bay, March 16, four specimens in all were seined.

Platophrys leopardinus (*Günther*).

Cape San Lucas, March 23, two specimens seined.

Syacium ovale (*Günther*).

Carmen I., April 3, one specimen seined.

Citharichthys gilberti *Jenkins and Evermann.*

San Jose del Cabo, March 26, one specimen seined in fresh water.

Etropus crossotus *Jordan and Gilbert.*

Ballenas Bay at Abreojos Point, March 16; Santa Maria Bay, March 18; Magdalena Bay, March 20 and 21, and Port San Bartholome, April 23. Numerous specimens were seined, and at Magdalena Bay a number were taken at 13 fathoms.

SOLEIDÆ. SOLES.

Symphurus fasciolaris *Gilbert.*

Port San Bartholome, March 13, Carmen I., April 3, and Tiburon I., April 12, seined, one specimen from each locality.

Symphurus atricaudus (*Jordan and Gilbert*).

Cerros I., March 12; Port San Bartholome, March 13, and Cape San Lucas, March 23, one specimen seined at each place.

Symphurus williamsi *Jordan and Culver.*

Cape San Lucas, March 23, one taken in the seine.

59.82(8)

Article XVII. — SOME APPARENTLY UNDESCRIBED BIRDS FROM THE COLLECTION OF THE ROOSEVELT SOUTH AMERICAN EXPEDITION.

By George K. Cherrie.

This paper is the first dealing directly with the ornithological collections brought together by the Roosevelt South American Expedition. Of the four hundred-odd species and subspecies represented in that collection, it is not surprising that there should be a number that are new to the ornithologist. The descriptions of some of the apparently undescribed birds are presented herewith.

The collection contains specimens from a very wide area and from localities with widely different climatic conditions. Owing to the character of the expedition (constantly moving) the collections from the different localities are necessarily fragmentary, and may not be so much as representative. However, the energies of the collectors were directed toward the securing of as large a number of species as possible from each locality in order that the whole might give us an insight into the relationships of the faunas of the different regions.

Little time was given to the study of life histories, but it is hoped that additional notes and observations on habits may be gathered during a proposed supplementary expedition, and incorporated with the completed report on the Roosevelt South American Expedition.

Chætura chapmani viridipennis subsp. nov.

Char. subsp.— Similar to *C. chapmani chapmani* but larger and differs in having the pileum, mantle and wings glossed with greenish (instead of steel-blue).

Type.— ♂ ad., Am. Mus. No. 127383, Doze Octobre, Matto Grosso, Feb. 17, 1914; Geo. K. Cherrie. Wing, 127; tail, 42; bill, 6 mm.

Remarks.— Only a single specimen was secured. It has been compared with a good series of typical *C. chapmani chapmani.*

Celeus roosevelti sp. nov.

Char. sp.— Similar to *C. lugubris* but both outer and inner webs of secondaries and inner primaries hazel-brown regularly barred on inner webs with black.

Type.— ♀ ad., Am. Mus. No. 127134, Tapirapoan, Matto Grosso, Jan. 17, 1914; Roosevelt Expedition (No. 17754, Geo K. Cherrie). Wing, 145; tail, 93; bill, 28 mm.

Description of Type.— General color of back, scapulars and wing-coverts a dusky rufous-brown. The back and scapulars regularly barred with ochraceous-buff, the bars on the wing-coverts being brace-shaped. Entire head, neck, chin and upper throat a warm buff; cheeks dusky brownish, the feathers tipped with ochraceous-buff, the color extending posteriorly in streaks along the sides of the throat where it merges into the hazel-brown of the lower throat, breast and belly. Primaries brownish black, all but the two outermost ones hazel-brown at base of both the outer and inner webs, the hazel area increasing progressively and occupying the entire web on the two innermost. Secondaries hazel-brown (both webs) regularly barred with black, but the bars not extending to the edge of the outer webs. Primaries also barred with black on the rufous inner webs. Shafts of the primaries brownish black, those of the secondaries reddish brown. Rump bright yellow, upper tail-coverts hazel-brown like the secondaries. Tail black (the dwarf side feathers are missing). Under wing-coverts, axillaries, sides, flanks and tibia yellowish buff. Flanks barred with dusky. Under tail-coverts uniform with belly.

Myrmotherula kermiti sp. nov.

Char. sp.— Similar to *M. pygmœa pygmœa* but general color of underparts brighter yellow (pale lemon-yellow) particularly on the chin and throat, where there is not any of the buffy color characteristic of females of *p. pygmœa,* and the lower throat with very distinct black, elongated shaft-spots.

Type.— ♀, Am. Mus. No. 127594, Barão Melgaço, Matto Grosso, March 6, 1914; L. E. Miller.

Description of Type.— Above black, the feathers of the forehead, crown and occiput broadly edged with warm buff, more intense on the forehead and becoming paler on the occiput where it merges into the straw-yellow of the edges of the mantle feathers. Wings black, greater and middle coverts tipped with straw-yellow, tertials broadly edged and primaries and secondaries, except outermost primary, narrowly edged with same color. Tail slate-gray, narrowly tipped and edged with pale yellow or straw-color, and with a distinct subterminal black spot. Sides of face and auriculars ochraceous-buff. Underparts pale lemon-yellow, brightest on throat. Center and sides of lower throat with distinct black, elongated shaft-spots, and a few more elongated shaft-streaks along sides and flanks. Under wing-coverts, bend of wing and axillaries pale lemon-yellow. Maxilla black, mandible dusky, feet slate-gray (in the dry skin).

I take pleasure in dedicating this new Ant-wren to Kermit Roosevelt, as a token of my esteem for a good camp companion and a friend.

Rhopoterpe torquata tragicus subsp. nov.

Char. subsp.— Similar to *R. torquata torquata* but distinguished by a broader white band across the inner webs of the remiges, which is also relatively nearer the base of the quills.

Type.— ♀ ad., Am. Mus. No. 127669, Rio Roosevelt, "Camp 17," Matto Grosso, March 27, 1914; Geo. K. Cherrie. Feet reddish slate-gray; bill black; eye light brown. Wing, 91; tail, 36; bill, 21 mm.

Remarks.— This specimen represents a race quite distinct from those inhabiting Cayenne and the Caura River district (as represented by specimens collected at Suapure by Klages), and also differing from Caquetá, Colombia, specimens. It may be distinguished from each by the broader white band across the inner webs of the remiges (on the innermost primary at least one cm. in width and less than one-half that width on the outermost) being nearer the base of the quills (not over one cm. from the tips of the under primary coverts). The underparts in general are paler; in addition the gray breast and belly has a decided olive-brown wash; while the narrow blackish pectoral line (formed by blackish tips to the hazel-brown feathers of the lower throat bordering the gray breast in the Caura specimen) is indicated by dusky tips to a few feathers only. The under tail-coverts are cinnamon-rufous (in *t. torquata* dark hazel).

Only one form of *R. torquata* has hitherto been recognized, its range extending from British and French Guiana southward and westward to the Amazon and its tributaries the Tapajos, the Madeira, and the Negro; also recorded from eastern Ecuador. The material before me somewhat extends the range of the species northward and westward as shown by specimens from Venezuela (Caura River) and Colombia (Caquetá). It also indicates that there are at least three fairly well-marked races. The type form, *torquata torquata* from Cayenne, in which the white band on the inner webs of the wing-quills (between 15 and 20 mm. from tips of under wing-coverts) is narrow, on the innermost primary not over 8 mm. in width, and rapidly narrowing becomes obsolete on the two outermost; and with a narrow blackish breast-band or line formed by blackish tips to the hazel-brown lower throat feathers where they meet the slate-gray feathers of the breast. A Matto Grosso race, *torquata tragicus* (described above), and a race from Colombia (La Murella, Caquetá) with a considerably restricted hazel-brown area of the throat (scarcely extending to the lower throat) and the black chin and cheeks (not flecked with white), characters that at once separate the female from those of *t. torquata* and *t. tragicus*. The characters of the male are less apparent but there is apparently a greater amount of transverse black barring on the breast.

Synallaxis rufogularis sp. nov.

Char. sp.— Closely resembles *S. rutilans*, but is distinguished by the entire absence of a black throat-patch.

Type.— ♂ ad., Am. Mus. No. 127726, Barão Melgaço, Matto Grosso, March 9, 1914; Leo E. Miller. Wing, 76; tail, 57; bill, 11.5 mm.

Description of Type.— Forehead, superciliary region, sides of head and neck, throat, foreneck and breast bright hazel-brown; crown, occiput and mantle raw-umber with a rufous or brown wash, particularly on the crown. Lateral interscapular feathers broadly edged with hazel-brown. Color of the back shading into fuliginous on the rump and upper tail-coverts. Center of belly olive-gray washed with buff and shading into dull mouse-gray with olive wash on sides and under tail-coverts. Wings and tail brownish black, the latter without paler edges. Median and lesser wing-coverts bright hazel-brown and greater wing-coverts broadly edged with the same color. Primary quills narrowly edged on outer webs with the color of the back, with a rufous wash. Inner edges of quills without lighter edges.

Phacellodomus ruber rubicula subsp. nov.

Char. subsp.— Similar to *P. ruber ruber* but much more rufous above (the interscapulars and outer surface of wing hazel-brown) instead of nearly uniform raw-umber from nape to rump.

Type.— ♂ ad., Am. Mus. No. 127731, San Lorenzo River, Matto Grosso, Jan. 2, 1914; Geo. K. Cherrie. Wing, 76; tail, 88; bill, 15.5 mm.

Description of Type.— Forehead, crown and occiput chestnut-brown; the interscapulars and outer surface of the wings nearly hazel; between the occiput and the interscapulars there is a cinnamon-brown area; also the lower back is cinnamon-brown, merging on the rump and upper tail-coverts into auburn, uniform with the tail. Below a soiled vinaceous-buff, nearly white on the chin and throat with a decided wash of cinnamon across the breast; sides, flanks and under tail-coverts dull cinnamon-brown; under wing-coverts bright pinkish cinnamon.

Remarks.— A single specimen of this race was collected on the San Lorenzo River, Matto Grosso, and much to the north of what seems to be the centre of distribution for *ruber ruber.* It may be the same as the "*P. ruber*" described by Mr. Sclater [1] as "above nearly uniform chestnut-red."

Philydor erythrocercus lyra [2] subsp. nov.

Char. subsp.— Similar to *P. erythrocercus erythrocercus* but more brownish and less olive both above and below.

Type.— ♀ ad., No. 127750 Am. Mus. Coll., 6th of March Rapids, Rio Roosevelt, Matto Grosso, March 8, 1914; Geo. K. Cherrie. Feet oil-green, maxilla blackish, mandible gray. Wing, 86; tail, 69 mm.

Description of Type.— Above head and mantle raw umber merging into chestnut on the rump and upper tail-coverts; tail chestnut; outer surface of wing, including lesser, median and greater coverts, between a cinnamon-brown and a Dresden-brown; inner webs of remiges mummy-brown edged with ochraceous-tawny; under wing-coverts ochraceous-tawny. Below chin and throat cream color, blending abruptly into a brownish chamois in the middle of the breast and belly; sides of breast and flanks much browner, the latter and under tail-coverts being almost exactly the Dresden-brown of Ridgway's 'Color Standards.'

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[1] Catalogue of Birds, XV, 1890, p. 80.

[2] I have pleasure in dedicating this race of the dusky-vented *Philydor* to Lieutenant Lyra, of the Roosevelt-Rondon scientific expedition.

Xiphocolaptes major saturatus subsp. nov.

Char. subsp.— Similar to *X. major castaneus* but decidedly darker, deeper colored both above and below.

Type.— ♂ ad., Amer. Mus. No. 127785, Urucum, near Corumbá, Matto Grosso, Dec. 4, 1913; Geo. K. Cherrie. Eye dark, feet greenish plumbeous. Wing, 145; tail, 93; bill, 49 mm.

Description of Type.— Head dark cinnamon-brown; lores dusky, ear coverts and ill-defined circle about the eye chestnut; color deepening on occiput and hind neck into auburn on back and into chestnut brown on tail. Feathers on crown, occiput and hind neck show very faint (nearly obsolete) pale shaft-lines. Below chin and throat cinnamon-brown shading into russet on breast and sides and darkening into chestnut on abdomen, under tail-coverts and tail. The breast and sides with buffy or tawny shaft-streaks.

Remarks.— Five specimens, collected at Urucum. Two that are immature have the chin and throat pale brownish russet and the remaining underparts less russet and more cinnamon. The pale shaft-streaks on the breast are a little more prominent.

Woodhewers of this race were usually seen in pairs.

Picolaptes angustirostris prædatus subsp. nov.

Char. subsp.— Similar to *P. angustirostris angustirostris* but larger and bill longer.

Type.— ♀ ad., Am. Mus. No. 36101, Concepcion del Uruguay, Sept. 29, 1880; W. B. Barrows. Wing, 100; tail, 81; bill, 40 mm.

Remarks.— In the type the feathers of the mantle are pale olive-brown with nearly concealed hazel-brown centers; rump, upper tail-coverts and tail hazel; forehead, crown and occiput dusky blackish, the feathers marked with grayish white shaft-streaks. The streaking on the crown and nape extends further back than in *P. a. angustirostris.* The outer webs of the wing-quills (except tips of primaries which are blackish) are hazel edged with pale grayish olive (which is the general color of the outer wing surface). The greater wing-coverts are rather broadly edged with a color between a drab and a pale grayish olive, well-defined on the generally darker wing surface. The dusky blackish edges of the feathers of the underparts are more pronounced than in *P. a. angustirostris.*

Another example from the same locality as the type taken Aug. 28, 1880, is without sex mark. It measures: Wing, 100; tail, 78; bill, 36 mm.

Habitat.— Uruguay.

Myiopagis viridicata rondoni[1] subsp. nov.

Char. subsp.— Similar to *M. viridicata viridicata* but paler both above and below.

Type.— ♂ ad., Am. Mus. No. 127860, Urucum, near Corumbá, Matto Grosso, Dec. 13, 1913 (No. 17411, Geo. K. Cherrie).

Remarks.— Five specimens from Ururum and one from Chapada, Matto Grosso, are at a glance distinguishable from Paraguayan birds (typical *viridicata viridicata*) by the paler underparts, chin and throat grayish white deepening somewhat on the chest where there is a wash of grayish olive, the remaining underparts naphthaline-yellow (much paler than the bright citron-yellow of the Paraguayan bird). Above they are as easily distinguished by their grayish olive (not clear dark olive) backs and rich lemon-yellow (instead of cadmium) crown-patches.

Sporophila hypoleuca clara subsp. nov.

Char. subsp.— Similar to *S. h. hypoleuca* from eastern Brazil (Bahia) but the slate-gray above deeper and darker, and with *a narrow white band across the rump.* Below almost pure white without the ash-gray wash on lower throat, foreneck, sides of body and flanks so prominent in *h. hypoleuca.*

Type.— ♂ ad., Am. Mus. No. 128119, San Lorenzo River (below the mouth of the Cuyabá), Matto Grosso, Jan. 2, 1914; Geo K. Cherrie (No. 17624).

Description of Type.— Above intermediate between deep neutral gray and dark neutral gray (Ridgway's 'Color Standards'); lores and sides of face uniform with crown. Wings and tail blackish. Wing and tail-quills narrowly edged with color of the back. A narrow grayish white band across the rump produced by white tips to some of the feathers. Inner primaries white at base of both inner and outer webs, the white patch at the base of the outer webs forming a speculum. Below almost pure white with only a trace of ash-gray wash on the lower throat, foreneck and sides. Wing, 62; tail, 50 mm.

Remarks.— A female, Am. Mus. No. 128121 (San Lorenzo River, below the mouth of the R. Cuyabá, Matto Grosso, Jan. 2, 1914; Geo. K. Cherrie), has the upperparts brownish olive with faint wash of rufous or orange on rump and upper tail-coverts. Wings and tail brownish black edged with color of the back. Sides of face paler brownish olive, the auriculars with narrow buffy shaft-lines. Below chin and upper throat white with pale buffy wash; breast and belly cream-buff with cinnamon-buff wash in center of lower throat, along the sides and flanks; under tail-coverts cinnamon-buff; sides of lower throat and breast pale brownish olive with cinnamon-buff wash. Under wing-coverts pale buffy white. Wing, 62; tail, 53 mm.

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[1] I take pleasure in naming this race in honor of Colonel Rondon of the Brazilian Army, who has so greatly increased our knowledge of the interior of Matto Grosso by his indefatigable labors as an explorer.

♂ im., Am. Mus. No. 128120, San Lorenzo River, Matto Grosso, Jan. 2, 1914; Geo. K. Cherrie (No. 17626).

Above deep grayish olive with ochraceous or buffy wash on rump and upper tail-coverts; below exactly similar to the adult female described above. Wing, 63; tail, 54 mm.

There is another specimen in the collection from Corumbá (H. H. Smith Collection) labeled ♂ that doubtless is an immature bird. It is similar to the immature male described above, but more brownish on upperparts.

Myospiza manimbe nigrostriata subsp. nov.

Char. subsp.— Similar to *M. imanimbe imanimbe* but upperparts gray rather than rufous and the general tone of the head and back uniform.

Type.— ♀ ad., Am. Mus. No. 127061 (brooding), Rio Negro,[1] Paraguayan Chaco, Nov. 12, 1913; Geo. K. Cherrie and L. E. Miller.

Description of Type.— General color above gray heavily streaked with blackish, the feathers of the crown, nape and back with rather broad black center streaks bordered with gray; on the rump and upper tail-coverts the outline of the blackish centers to the feathers is not so sharply defined. Edge of wing bright yellow, lesser wing-coverts with dusky blackish centers washed and edged with olive-yellow; median and greater coverts blackish edged and tipped with pale buffy gray; primary coverts dusky, edged with grayish. Quills and tail-feathers dusky brownish, the primaries narrowly edged with grayish, secondaries edged with grayish rufous; rectrices narrowly edged with grayish. Lores gray, with a yellow supraloral streak that extends to above the eye where it is merged into a dull gray stripe extending back to above auriculars, but separated from them by a blackish streak extending back from the eye; feathers on eyelids dull whitish; ear-coverts and sides of face dull gray, an ill-defined blackish stripe extending from the rictus below the eye and joining the supra-auricular stripe. Sides of neck dull gray, streaked with black; chin and upper throat grayish, lower throat and fore-neck grayish vinaceous-buff; this color extending on to the sides and flanks where it becomes buffy brownish. Center of breast and abdomen whitish, under tail-coverts pale buffy.

Remarks.— The type of this new race, a brooding bird, compared with a brooding female of true *manimbe* is at a glance distinguishable by the almost entire absence of rufous coloring above and in that the general color of the head and back is uniform.

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[1] A small tributary of the Rio Pilcomayo entering thirty-five or forty miles from its mouth.

Thraupis palmarum duvida subsp. nov.

Char. subsp.— Similar to *T. p. melanoptera* and *p. violilavata* but with middle and greater wing-coverts grayish blue-violet instead of yellowish olive, and in the absence of a well-defined yellowish olive area at the base of the remiges.

Type.— ♂, Am. Mus. No. 128245, Carapana, Rio Roosevelt, Amazonia, Brazil, Apr. 24, 1914; Geo. K. Cherrie (Roosevelt Expedition). Carapana is near the mouth of the Rio Roosevelt.

Description of Type.— General color glossy olive, washed above and below with somewhat irregular blotches of grayish blue-violet. The shoulders and lesser wing-coverts bluish violet; greater and middle coverts uniform light grayish blue-violet. The general olive color passes into light olive greenish on the forehead, crown and auricular region. Remiges and primary-coverts brownish black or sooty, faintly edged with olive; tail brownish black faintly edged with olive.

Remarks.— *T. p. duvida* differs from *p. melanoptera* and *p. violilavata* in the light grayish blue-violet (not yellowish olive) middle and greater wing-coverts; and in the absence of a well-defined yellowish olive area at the base of the remiges. The pale yellowish or buffy area on the under surfaces of the wing at the base of the inner webs of the remiges much more restricted, in the outer primary not extending to the quill.

Only a single specimen of this apparently new race was secured.

59.9(86)

Article XVIII.—LIST OF MAMMALS COLLECTED IN COLOMBIA BY THE AMERICAN MUSEUM OF NATURAL HISTORY EXPEDITIONS, 1910–1915.

By J. A. Allen.

CONTENTS.

Page
Introduction 191
Itineraries 191
List of localities, with map 194
Bibliography 196
List of species and subspecies based on the Colombia collections . . . 197
Acknowledgments 199
Systematic list 200
Alouatta seniculus group 228

Introduction.

The collections of mammals, of which the present paper is a summary account, were made at various localities in Colombia, but almost wholly in the Andean portion of the Republic, the Orinoco-Amazon drainage area being only slightly entered at a few points along the eastern base of the highlands. The expeditionary work was planned and directed by my colleague Dr. Frank M. Chapman, Curator of Ornithology, who also shared in the field work and thus gained personal knowledge of the topography and the physical conditions of the areas explored.

Ornithological research was the primary object of the expeditions, to which the collecting of mammals was subsidiary and incidental, nevertheless about 1370 mammals were obtained, representing about 186 species and subspecies. They were mainly collected by Leo E. Miller and William B. Richardson.[1]

Itineraries.

Collecting was begun in southwestern Colombia by William B. Richardson, who reached Buenaventura November 9, 1910, and proceeded at once to Caldas (alt. 2560 ft.), and later to San José (alt. 600 ft.). On December

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[1] A detailed account by Dr. Chapman of the personnel and the itineraries of the expeditions, with maps showing routes travelled, the topography and life zones of Colombia, will be found in Volume XXXVI of this Bulletin, now in press, and which will be issued probably early in 1917. It is therefore necessary in this connection to give only a brief outline of the field work as it relates to the mammals. The itineraries given below are based on Dr. Chapman's manuscripts.

18 he went to Cali (alt. 3500 ft.), at the eastern base of the Western Andes, where he collected till the end of December, and then moved on to the mouth of the pass (alt. 6600 ft.) known as Las Cruces, and also as San Antonio. Here he collected till the end of February, when he moved to Las Lomitas (alt. 5000 ft.), a ranch on the western slope some five miles northwest of San Antonio. After spending a week at this point he descended to Los Cisneros (or Juntas, alt. 900 ft.) where he collected till March 21. Two days later he reached Buenaventura, where he was joined by Dr. Chapman, Louis A. Fuertes and Leo E. Miller. The whole party then proceeded to Cali, which they reached April 8, and which became their principal base for the rest of the year. From Cali they went at once to La Manuelita, a sugar estate in the Cauca Valley some five miles north of Palmira, where they were the guests of Mr. Charles J. Eder till the 18th, when they proceeded with pack animals to Miraflores (alt. about 6000 ft. above sea level and 3000 ft. above the valley) on the western slope of the Central Andes. On May 1 they started on the return journey to Cali, via La Florida and Güengüe, where a few specimens were collected, Cali being reached May 7.

On May 13 Miller and Richardson left Cali with pack mules on an expedition to the region west of Popayán, about one degree of latitude south of San Antonio. They left Popayán (alt. 5700 ft.) for Cerro Munchiqui May 20, their first collecting station being at an elevation of 8325 ft. Here they remained from May 22 to June 4, when they went to Cocal (alt. 4000 ft.), and on June 16 returned to Popayán for supplies. They left again on June 24, collecting at Gallera (alt. 5700 ft.) from June 26 to July 4, at La Florida (alt. 7700 ft.) from July 5 to 9, and on the summit of the first ridge of the Western Andes (alt. 10,340 ft.) from July 10 to 23, returning on July 27 to Cali, via Popayán.

This terminated the collecting in the southern part of the Western Andes. Later Richardson resumed work in the southwestern coast region, beginning at Barbacoas (alt. 75 ft., on the Rio Patia), early in August, 1912, where he remained for about one month, when an attack of beri-beri forced him to seek higher altitudes. He then visited Buenavista (alt. 1200 ft.) and Ricuarte (alt. 5000 ft.), collecting for about two weeks at each of these localities, reaching Tumacos October 13, whence he sailed for Esmeraldas, Ecuador.[1]

Mr. Miller left Cali with Dr. Arthur A. Allen, who had now joined the expedition, on a Cauca River steamer for Cartago on August 22, 1911, arriving at Cartago three days later, and reaching Laguneta, just below the Quindio Pass, on the 28th, where they pitched their tent at an altitude of 10,300 feet, to begin their work in the Central Andes. They remained at this point until September 11, when they retraced their steps to Salento and then began the ascent to Santa Isabel through the Boquilla Valley, reaching the paramo (alt. 12,700 ft.) two days later. Here they collected until the 20th, when they moved to a point about 1000 feet lower, there collecting for three days before they returned to Salento. From Salento they began their trip over the Quindio Trail to Chicoral and the Magdalena Valley, making a cross-section over the Central Andes from the Rio Cauca to the Rio Magdalena. On their return they collected several days each at El Eden (alt. 8300 ft.) and Rio Toché (alt. 6800 ft.), reaching Salento on their return October 31. Here they collected till November 13, when they returned to Cartago en route to Rio Frio on the Rio Cauca. At this point they worked in the heavy forest until the 2nd of December, when they returned to Cartago, to cross the Western Andes to the coast. Few specimens were collected till Juntus de Tamaná was reached (alt. 400 ft., Dec. 14–20); other collections were made at Nóvita (alt. 1500 ft., Dec. 21–27). Both men were here taken severely ill from malaria and were obliged to return to Cali for recuperation and medical treatment.

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[1] A general account of the Mammals collected by him in Ecuador has already appeared in this volume of the Bulletin (pp. 113–125).

At the end of February, 1912, Miller and Allen set out from Cali, via the route of Miller and Richardson in May, 1911, for Popayán, and thence continued on foot to La Sierra (alt. 6800 ft., Feb. 29–March 4) and Almaguer (alt. 10,300 ft., March 9–18), here turning east to cross the Magdalena Valley, stopping at Valle de las Papas (alt. 10,000 ft., March 22–April 4), and reaching San Agustin (alt. 5000 ft., April 7–25). Here Dr. Allen suffered so severely from a recurrence of the fever acquired in the Chocó that he was compelled to seek medical treatment at Bogotá, and finally to return home. Miller continued on to La Palma (alt. 5500 ft., April 27–May 5) and to La Candela (alt. 6000 ft., May 7–19), returning to San Agustin May 20. From this point he made an expedition over the Eastern Andes to the Caquetá region, crossing at Andalusia (alt. 7000 ft.), collecting at Florencia (alt. 1000 ft., June 24–July 6), and Muralla (La Murelia of earlier papers; alt. 500 ft., July 8–26). The two last named localities are in the Amazonian drainage, and the mammals collected there were different from those collected elsewhere in Colombia.

In August, 1912, Miller returned to New York, after an absence of nearly two years on collecting expeditions in Colombia. Some months later he returned to South America, collecting in Venezuela and Guiana till he joined the Roosevelt Expedition to southern Brazil late in 1913. Returning safely from this eventful journey he again resumed his explorations in Colombia, this time in Antioquia, extending his field of research much to the northward in the Western Andes of Colombia. On this expedition he was accompanied by Howarth S. Boyle, of the American Museum, as assistant. They collected here from November, 1914, to March, 1915, when they were transferred to Bolivia and have now (April, 1916) worked southward to southern Argentina.

In the early part of 1913 (Jan. 19–April 16) Dr. Chapman again visited Colombia, with a corps of assistants which included George K. Cherrie and G. M. O'Connell, with Louis A. Fuertes as artist. The party ascended the Rio Magdalena as far as Honda (alt. 600 ft.), collecting very little on the river journey but making a zoölogical reconnaissance from the Rio Magdalena across the Andes to the Orinoco drainage. On this journey Mr. O'Connell made a small collection of mammals, assisted to some extent by other members of the expedition.

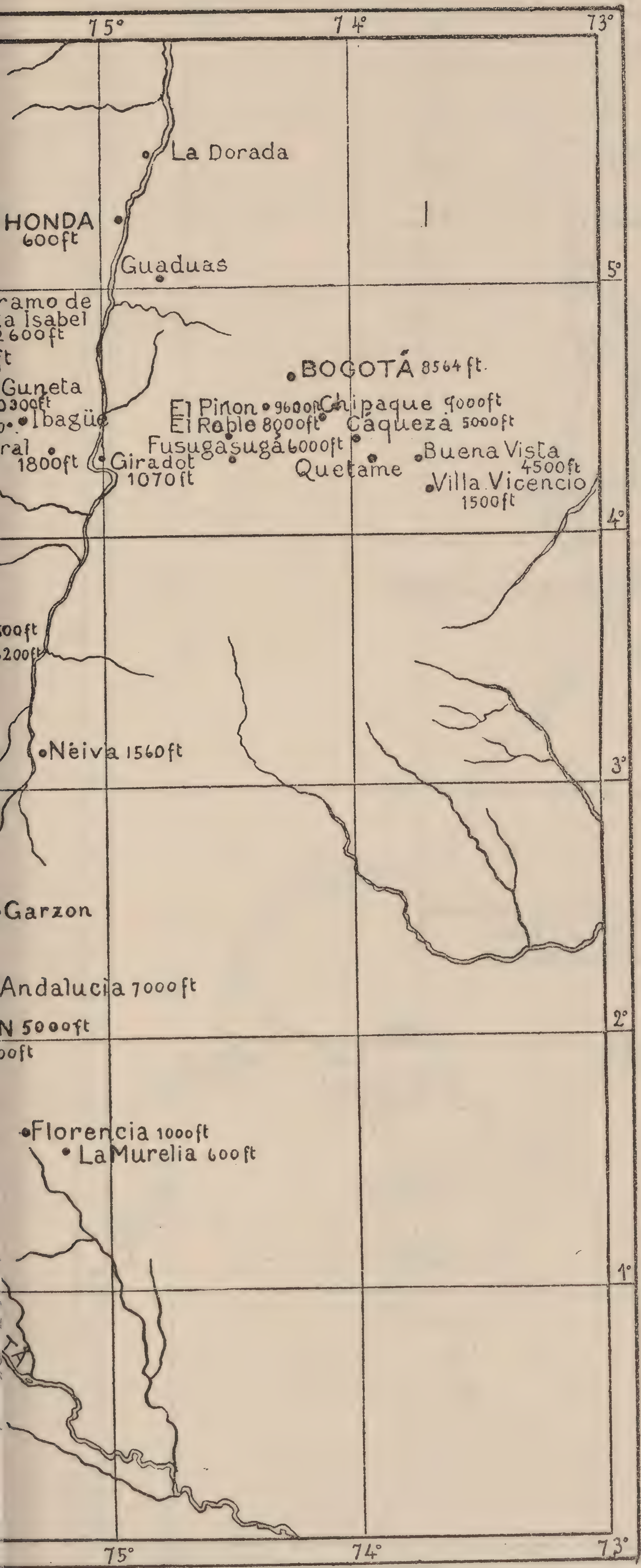
In the meantime small collections of mammals from Colombia were received from other sources, as noted below in the list of localities, making a total, as stated above, of about 1370 specimens, of which about 260 were collected by Mr. Richardson and about 950 by Mr. Miller (including jointly the work of his assistant Mr. Boyle), about 150 having been derived from other sources.

List of Localities.

The following list of localities, most of which are shown on the accompanying sketch map, prepared by Dr. Chapman for use in his preliminary papers on the birds collected on these expeditions, indicate the geographical sources of the mammal collections here summarized, with the approximate altitudes of the localities, the dates of collecting, and the number of specimens obtained at each.

William B. Richardson, southwestern Colombia, November 9, 1910, to July 30, 1911, and August 6–Oct. 10, 1912.

Caldas, Nov. 18–29. Altitude 1800 feet. 8 specimens.
San José, Nov. 29–Dec. 11. Alt. 200 ft. 38 specimens.
Cali, Dec. 22. Alt. 3500 ft. 3 specimens.
San Antonio and vicinity, Jan. 18–March 31. Alt. 6800 ft. 62 specimens.
Las Lomitas, Feb. 26–March 4. Alt. 5000 ft. 22 specimens.
Los Cisneros (or Juntas), March 19–21. Alt. 600 ft. 2 specimens.
Miraflores, April 13–May 1. Alt. 6200 ft. 29 specimens.
Güengüe, May 5. Alt. 3500 ft. 3 specimens.
Juanchito (the port of Cali), May 9. Alt. 3500 ft. 2 specimens.
Barbacoas, Aug. 10–15, and Oct. 5. Alt. 75 ft. 71 specimens.
Ricuarte, Sept. 18–20. Alt. 5000 ft. 11 specimens.
Buenavista. Alt. 1200 ft. 15 specimens. Total, 263 specimens.



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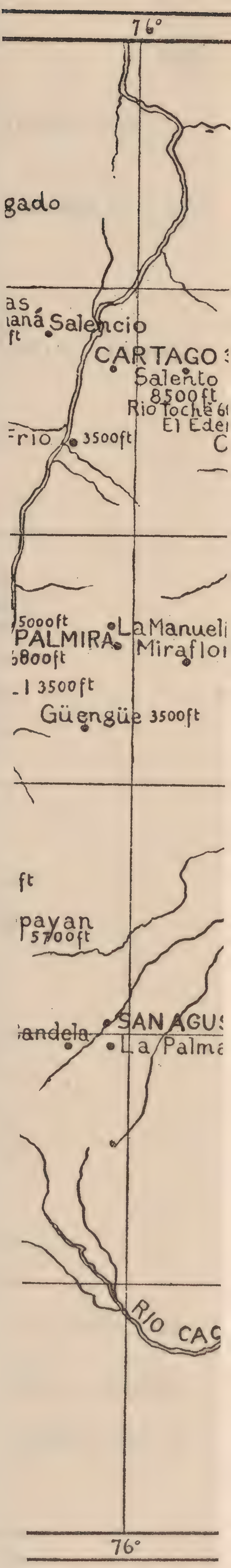

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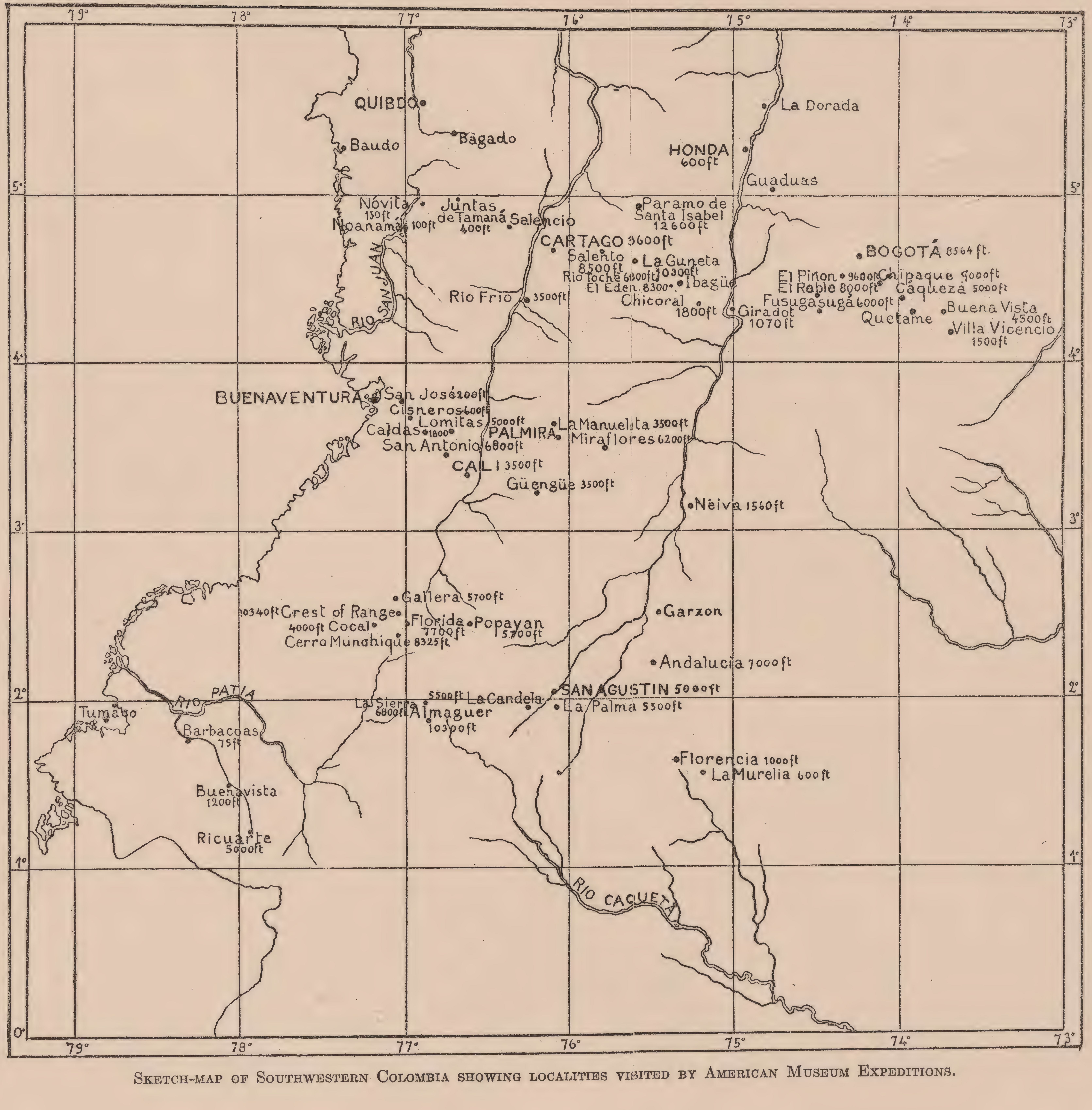

SKETCH-MAP OF SOUTHWESTERN COLOMBIA SHOWING LOCALITIES VISITED BY AMERICAN MUSEUM EXPEDITIONS.

Leo E. Miller, Western and Central Andes, March 23, 1911, to July 24, 1912.

Western Andes.

Munchique (or Cerro Munchique), May 27–June 8. Alt. 7000–8325 ft. 102 specimens.

Cocal, June 10–17. Alt. 4000 ft. 42 specimens.

Gallera, June 28–July 15. Alt. 5000–5700 ft. 42 specimens.

La Florida, July 6–9. Alt. 7700 ft. 12 specimens.

Crest of Western Andes (west of Popayán), July 13–22. Alt. 10,340 ft. 70 specimens.

Belen, July 28. Alt. 6000 ft. 1 specimen.

Central Andes.

La Guneta, Aug. 28–Sept. 8. Alt. 10,300 ft. 31 specimens.

Paramo de Santa Isabel, Sept. 16–24. Alt. 12,600 ft. 7 specimens.

Salento, Sept. 25–Oct. 8. Alt. 7000–9000 ft. 65 specimens.

Chicoral, Oct. 8–12. Alt. 1800 ft. 5 specimens.

El Eden, Oct. 18–20. Alt. 8300 ft. 6 specimens.

Rio Toché, Oct. 24–27. Alt. 6800 ft. 44 specimens.

West Quindio Andes, Nov. 3–7. Alt. 9000 ft. 6 specimens.

El Roble, Nov. 9–11. Alt. 7000 ft. 35 specimens.

Rio Frio, Nov. 24–Dec. 1. Alt. 3500 ft. 87 specimens.

Western Andes.

Salencio, Dec. 8–12. Alt. 6000 ft. 6 specimens.

Juntas de Tamaná, Dec. 15–18. Alt. 4000 ft. 10 specimens.

Chocó, Upper Rio San Juan.

Novita, Dec. 25–27. Alt. 150 ft. 19 specimens.

Nouanama, Dec. 31–Jan. 1. Alt. 100 ft. 3 specimens.

Southern Eastern Andes.

La Sierra, March 1–3. Alt. 6800 ft. 9 specimens.

Almaguer, March 8–11. Alt. 10,300 ft. 10 specimens.

Valle de las Papas, March 25. Alt. 10,000 ft. 14 specimens.

San Agustin, April 27–May 5. Alt. 5500 ft. 21 specimens.

La Candela, May 11–16. Alt. 6000 ft. 22 specimens.

Andalusia, June 6–8. Alt. 5000 ft. 33 specimens.

Rio Caquetá drainage.

Florencia, June 27–July 3. Alt. 675 ft. 56 specimens.

Muralla (wrongly given as La Murelia in the preliminary papers), July 7–24. Alt. 600 ft. 68 specimens.

Total, 725 specimens, plus about 50, of which the labels were lost or illegible.

Leo E. Miller and Howarth S. Boyle, Province of Antioquia, northern part of Western Andes, November 25, 1914–March 25, 1915.

Barro Blanco, Nov. 25–28. Alt. 7200 ft. 9 specimens.

Santa Elena, Dec. 1–4. Alt. 9000 ft. 30 specimens.

Puerto Valdivia, Dec. 14–26. Alt. 360 ft. 38 specimens.
La Frijolera, Dec. 30–Jan. 4. Alt. 5000 ft. 60 specimens.
Paramillo, Jan. 29–31. Alt. 12,500 ft. 12 specimens.
Dabeiba, Feb. 13. Alt. 300 ft. 17 specimens.
Alto Benito, Feb. 17–23. Alt. 1000 ft. 3 specimens.
Malera, March 9–11. Alt. 1000 ft. 3 specimens.
La Playa (near Baranquilla), March 23–25. Alt. 150 ft. 3 specimens.
Total, 175 specimens.

G. M. O'Connell, Eastern Andes, from the Rio Magdalena east to Buenavista, January 19 – April 16, 1913.

Rio Magdalena, Jan. 24–29. 4 specimens.
El Triunfo, Feb. 7–9. Alt. 600 ft. 8 specimens.
Chipaque, Feb. 22–24. Alt. 9000 ft. 6 specimens.
Buenavista, March 2–12. Alt. 4500 ft. 30 specimens.
Villavicencio, March 10–15. Alt. 1500 ft. 13 specimens.
Fusugasugá, March 24–30. Alt. 6000 ft. 17 specimens.
El Roble, April 1–4. Alt. 8000 ft. 6 specimens. Total, 84 specimens.

Other Sources.

About 50 specimens were purchased of Manuel Gonzales, a native collector, obtained within a radius of 15 to 20 miles of Bogotá, chiefly at Panama Largo, Subia, Quetame, and Anolaima.

About 40 specimens were purchased of Mrs. E. L. Kerr, collected chiefly at Baudo and Bogado, on the upper Rio Atrato.

About 25 specimens have been kindly presented by Hermano Apolinar Maria, Director of the Instituto de la Salle, Bogotá, collected also near Bogotá. They include several species not otherwise obtained, among them two (*Thrinacodus apolinari* and *Glossophaga apolinari*) not previously described, and two specimens of the rare Bogotá shrew (*Cryptotis thomasi*).

BIBLIOGRAPHY.

The following 13 papers, published in this Bulletin (Vols. XXXI–XXXV), have been based, in whole or in large part, on the collections of mammals from Colombia here under consideration:

1912. Mammals from Western Colombia. Vol. XXXI, pp. 71–95, April 19, 1912.
Fifty-five species and subspecies, based on about 400 specimens from the Cauca district, collected by Richardson (Nov. 29, 1910 – March 13, 1911) and Miller (April 18 – July 24, 1911). Eighteen forms described as new.

1913. New Mammals from Colombia and Ecuador. Vol. XXXII, pp. 469–484, figs. 1–18, Sept. 25, 1913.
Thirteen species, of which 9 are from Colombia and 4 from Ecuador.

1913. Revision of the *Melanomys* Group of American Muridæ. Vol. XXXII, pp. 535–555, pl. lxviii, Nov. 17, 1913.
Fourteen species and subspecies, of which 6 are described as new, — 5 from Colombia, 1 from Ecuador.

1913. New South American Muridæ. Vol. XXXII, pp. 597–604, Dec. 3, 1913.
Thirteen species and subspecies, of which 9 are from western Colombia, 1 from the Santa Marta region, 1 from Guiana, 2 from Venezuela.
1914. Review of the Genus *Microsciurus.* Vol. XXXIII, pp. 145–165, Feb. 26, 1914.
Nineteen forms recognized, 2 of which are described as new,— 1 from Colombia and 1 from Peru.
1914. New South American Bats and a New Octodont. Vol. XXXIII, pp. 381–389, pl. xxviii, July 9, 1914.
Twelve species, of which only 3 were from western Colombia.
1914. New South American Sciuridæ. Vol. XXXIII, pp. 585–597, Oct. 8, 1914.
One new genus and 12 new species and subspecies, of which 7 were based on specimens from western Colombia.
1914. New South American Monkeys. Vol. XXXIII, pp. 647–655, Dec. 14, 1914.
Nine species and subspecies, of which 3 were from western Colombia.
1915. Review of the South American Sciuridæ. Vol. XXXIV, pp. 147–309, pll. i–xiv, text figs. 1–25, May 17, 1915.
Five new genera and 1 new subgenus proposed, and 76 species and subspecies recognized, 3 of the latter described as new (2 of them from Colombia).
1915. Notes on American Deer of the Genus *Mazama.* Vol. XXXIV, pp. 521–553, Nov. 2, 1915.
Twenty-four species and subspecies recognized, of which 7 are described as new, only 1 of them based on the present collections from Colombia.
1915. New South American Mammals. Vol. XXXIV, pp. 625–634, Dec. 30, 1915.
Ten forms described as new, 3 of them from Colombia.
1916. New South American Mammals. Vol. XXXV, pp. 83–87, April 28, 1916.
Seven species and subspecies, of which 6 are based on western Colombia specimens.
1916. The Neotropical Weasels. Vol. XXXV, pp. 89–111, April 28, 1916.
Eight species and subspecies (1 of the latter new), of which only 2 are recognized as occurring in Colombia.

List of Species and Subspecies based on the Colombia Collections.

Following is a list of the species and subspecies based on the present Colombia collections, with their type localities and date and place of publication.

1. *Metachirus nudicaudatus antioquiæ,* XXXV,[1] p. 83, April 28, 1916. La Frijolera, Antioquia.
2. *Cholœpus florenciæ,* XXXII, Sept. 25, 1913. Florencia.
3. *Cholœpus agustinus, ibid.,* p. 470. San Agustin.
4. *Cholœpus andinus, ibid.,* p. 472. Salento.
5. *Cholœpus capitalis, ibid.,* p. 472. Barbacoas.
6. *Mazama murelia,* XXXIV, p. 547, Nov. 2, 1915. La Murelia (*lege* Muralla).
7. *Sylvilagus* (*Tapeti*) *fulvescens,* XXXI, p. 75, April 19, 1912. Belen, Western Andes.

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[1] Reference is in all cases to Bull. Amer. Mus. Nat. Hist.

8. *Sylvilagus* (*Tapeti*) *salentus*, XXXII, p. 476, Sept. 25, 1913. Salento.
9. *Sylvilagus boylei*, XXXV, p. 84, April 28, 1916. La Playa, near Baranquilla.
10. *Cavia anolaimæ*, XXXV, p. 85, April 28, 1916. Anolaima, Eastern Andes.
11. *Dasyprocta fuliginosa candelensis*, XXXIV, p. 625, Dec. 30, 1915. La Candela.
12. *Dasyprocta variegata chocoensis*, *ibid.*, p. 627. Los Cisneros, Chocó.
13. *Myoprocta milleri*, XXXII, p. 477, Sept. 25, 1913 (= *M. exilis milleri*, *postea*, p. 205). La Murelia (= Muralla).
14. *Proechimys o'connelli*, XXXII, p. 479, Sept. 25, 1913. Villavicencio.
15. *Thrinacodus apolinari*, XXXIII, p. 387, pl. xxviii, July 9, 1914. Tomaque, Eastern Andes.
16. *Heteromys lomitensis* (= *H. australis* Thomas), XXXI, p. 77, April 19, 1912.
17. *Reithrodontomys milleri*, *ibid.*, p. 77, Munchique.
18. *Rhipidomys mollissimus*, *ibid.*, p. 78. Palmira.
19. *Rhipidomys similis*, *ibid.*, p. 79. Cocal.
20. *Rhipidomys cocalensis*, *ibid.*, p. 79. Cocal.
21. *Rhipidomys quindianus*, XXXII, p. 600, Dec. 3, 1913. El Roble.
22. *Rhipidomys caucensis*, *ibid.*, p. 601, Munchique.
23. *Thomasomys cinereiventer*, XXXI, p. 80, April 19, 1912. Popayán.
24. *Thomasomys popayanus*, *ibid.*, p. 81. Popayán.
25. *Neacomys pusillus*, *ibid.*, p. 81. San José.
26. *Oryzomys helvolus*, XXXII, p. 597, Dec. 2, 1913. Villavicencio.
27. *Oryzomys o'connelli*, *ibid.*, p. 597. Buenavista, Eastern Andes.
28. *Oryzomys vicencianus*, *ibid.*, p. 598. Villavicencio.
29. *Oryzomys incertus*, *ibid.*, p. 598 (= *mureliæ*, XXXIV, p. 630, Dec. 30, 1915 — *incertus* preoccupied). La Murelia (= Muralla).
30. *Oryzomys barbacoas*, XXXV, p. 85, April 28, 1916. Barbacoas.
31. *Oryzomys palmiræ*, XXXI, p. 83, April 19, 1912. Palmira.
32. *Oryzomys pectoralis*, *ibid.*, p. 83. Popayán.
33. *Oryzomys* (*Oligoryzomys*) *munchiquensis*, *ibid.*, p. 85. La Florida.
34. *Oryzomys* (*Oligoryzomys*) *fulvirostris*, *ibid.*, p. 86. Munchique.
35. *Oryzomys* (*Melanomys*) *obscurior affinis*, *ibid.*, p. 88. (= *Melanomys affinis affinis*, XXXII, p. 539). San José.
36. *Melanomys affinis monticola*, XXXII, p. 540, Nov. 17, 1913. Gallera.
37. *Melanomys phæopus vallicola*, *ibid.*, p. 544. Rio Frio.
38. *Melanomys phæopus tolimensis*, *ibid.*, p. 545. Rio Toché.
39. *Melanomys lomitensis*, *ibid.*, p. 545. Las Lomitas.
40. *Melanomys buenavistæ*, *ibid.*, p. 547. Buenavista, Eastern Andes.
41. *Æpeomys fuscatus*, XXXI, p. 89, April 19, 1912. San Antonio.
42. *Microxus affinis*, *ibid.*, p. 89. San Antonio.
43. *Akodon tolimæ*, XXXII, p. 480, Sept. 25, 1913. Rio Toché.
44. *Akodon chapmani*, XXXII, p. 600, Dec. 3, 1913. Eastern Andes.
45. *Zygodontomys griseus*, *ibid.*, p. 599. El Triunfo, near Honda, Magdalena Valley.
46. *Zygodontomys fraterculus*, *ibid.*, p. 599, Chicoral, Tolima.
47. *Microsciurus florenciæ*, XXXIII, p. 163, Feb. 26, 1914. Florencia.
48. *Sciurus milleri*, XXXI, p. 91, April, 1912 (= *Mesosciurus gerrardi milleri*, XXXIV, p. 241, May 17, 1915). Cocal.
49. *Sciurus gerrardi salaquensis*, *ibid.*, p. 592 (= *Mesosciurus g. salaquensis*, XXXIV, p. 245, May 17, 1915). Rio Salaqui.

50. *Sciurus saltuensis magdalenæ, ibid.*, p. 593 (= *Mesosciurus s. magdalenæ*, XXXIV, p. 251, May 17, 1915). Banco, Rio Magdalena.
51. *Mesosciurus gerrardi baudensis*, XXXIV, p. 308, May 17, 1915. Baudo.
52. *Mesosciurus gerrardi valdiviæ, ibid.*, p. 309. Puerto Valdivia.
53. *Guerlinguetus pucheranii salentensis*, XXXIII, p. 587, Oct. 8, 1914 (= *Leptosciurus p. salentensis*, XXXIV, p. 203, May 17, 1915). Salento.
54. *Guerlinguetus hoffmanni quindianus, ibid.*, p. 587 (= *Mesosciurus h. quindianus*, p. 222, May 17, 1915). Rio Frio.
55. *Guerlinguetus griseimembra, ibid.*, p. 589 (= *Mesosciurus griseimembra*, XXXIV, p. 232, May, 1915). Buenavista, Eastern Andes.
56. *Guerlinguetus candelensis, ibid.*, p. 590 (= *Mesosciurus candelensis*, XXXIV, p. 235, May 17, 1915). La Candela.
57. *Guerlinguetus æstuans venustus*, XXXIV, p. 260, May 17, 1915. Boca Sina, base of Mt. Duida.
58. *Nasua olivacea lagunetæ*, XXXII, p. 483, Sept. 25, 1913. La Guneta.
59. *Potos flavus tolimensis, ibid.*, p. 486, Sept. 25, 1913. Giradot.
60. *Margay tigrina elenæ*, XXXIV, p. 631, Dec. 30, 1915. Santa Elena, Antioquia.
61. *Margay caucensis, ibid.*, p. 631, Las Pavas, Western Andes.
62. *Blarina* (*Cryptotis*) *squamipes*, XXXI, p. 93, April 19, 1912. Popayán.
63. *Glossophaga apolinari*, XXXV, p. 86, April 28, 1916. Boqueron de San Francisco, Eastern Andes.
64. *Eptesicus andinus*, XXXIII, p. 382, July 9, 1914. Valle de las Papas, Central Andes.
65. *Myotis caucensis, ibid.*, p. 386. Rio Frio.
66. *Alouatta seniculus bogotensis*, XXXIII, p. 648, Dec. 14, 1914. Subia, Eastern Andes.
67. *Alouatta seniculus caquetensis, ibid.*, p. 650. La Murelia (= Muralla).
68. *Ateles robustus, ibid.*, p. 652. Gallera.
69. *Saimiri caquetensis*, XXXV, p. 87, April 28, 1916. Florencia.

No new forms are described in the present paper, but here and there technical comment is added to the field records, particularly in the parts treating of the Muridæ, Carnivores and Primates.

ACKNOWLEDGMENTS.

In April, 1913, I took with me to the British Museum several hundred specimens from Colombia for direct comparison with the extensive South American material in that museum, including the types and topotypes of all the species described by me in 1912 and 1913. I wish here to express again[1] my sense of indebtedness to Oldfield Thomas, not only for the unrestricted use of the collections in his care, but also for valued assistance and advice, and for important information since conveyed through correspondence.

I wish also to record here my obligations to the leading museums in this country for specimens loaned for use in the identification of the mammals not only of Colombia but also from other South American countries during the progress of my work in this field; namely, to the United States National Museum, through Gerrit S. Miller, in charge of mammals; to Henry W. Henshaw, E. W. Nelson and A. E. Goldman of the Biological Survey; to the Field Museum of Natural History, through W. H. Osgood; to the Museum of Comparative Zoölogy, through the Director, Samuel Henshaw and Dr. G. M. Allen, curator of mammals; to the Academy of Natural Sciences of Philadelphia, through Dr. Witmer Stone; to the Carnegie Museum of Pittsburgh, through W. E. C. Todd.

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[1] *Cf.* this Bulletin, XXXIV, 1915, p. 150.

My colleague Dr. Chapman has kindly given me much helpful information respecting the situation of localities and their faunal relationships.

SYSTEMATIC LIST.

DIDELPHIIDÆ.

1. **Didelphis paraguayensis meridensis** *Allen.*

Two specimens: Fusugasugá, 1; El Roble, 1 (O'Connell).

2. **Didelphis paraguayensis andina** *Allen.*

Thirteen specimens: Munchique, 12 (Bull. XXXI, p. 74, 1912, Miller); Paramillo, Antioquia, 1 specimen (Miller and Boyle).

3. **Didelphis marsupialis etensis** *Allen.*

Twelve specimens: San José and Caldas, 3 (Richardson; Bull. XXXI, p. 74, 1912); Barbacoas, 6 (Richardson); Bagado, 3 (Kerr).

4. **Didelphis marsupialis caucæ** *Allen.*

Twenty-six specimens: Puerto Valdivia, 6; Barro Blanco, 1; La Frijolera, 3; Dabeiba, 2 (Miller and Boyle); Rio Frio, 2; Salento, 4; San Agustin and Andalucia, 1 each (Miller); Honda, 1 (O'Connell).

5. **Marmosa isthmica** *Goldman.*

Four specimens, San José and Las Lomitas (Richardson). (*Marmosa phœa* and *M. murina zeledoni*, Bull. XXXI, p. 73, 1912).

Of the four specimens thus recorded in 1912 (*l. c.*) only one was adult; the others were young and without skulls. Specimens of *M. phœa* since received (and compared with the type and topotypes of *phœa* in the British Museum) prove to be widely different from the San José and Las Lomitas specimens, which are now provisionally referred to *M. isthmica.* Much more and better material is necessary for their final determination.

6. **Marmosa mitis** *Bangs.*

Three specimens, El Triunfo (alt. 600 ft.), and Rio Magdalena, each 1 (O'Connell).

These specimens probably represent *M. m. pallidiventris* Osgood.

7. **Marmosa phæa** *Thomas.*

Five specimens: Ricuarte, 1 (Richardson); La Candela, 4 (Miller).

8. **Thylamys caucæ** (*Thomas*).

Four specimens, San Antonio (Richardson; Bull. XXXI, p. 73, 1912); Ricuarte, 1 (Richardson); near Salento, 1 (Miller); El Roble (near Bogotá), 1 (O'Connell).

These specimens are quite similar to *T. keaysi* from Inca Mines, Peru; *Marmosa invicta* Goldman, from Panama, is a closely related form.

9. **Metachirus opossum melanurus** *Thomas.*

Eleven specimens: Cocal, 2 (Miller; Bull. XXXI, p. 73, 1912); Bagado, 6 (Kerr); Alto Bonito, 3 (Miller and Boyle).

On direct comparison with the type and topotypes in the British Museum, the first eight of these specimens proved to be indistinguishable from *melanurus.*

10. **Metachirus opossum griscescens** *Allen.*

Two specimens, Rio Frio (Allen and Miller).

This is the pale form of the Cauca Valley region, differing from the coast form (*melanurus*) in smaller size and much paler coloration.

11. **Metachirus opossum** (subsp. nov.?).

One specimen, Villavicencio (alt. 1600 ft.), March 14 (O'Connell). Nearer true *M. opossum* than to either *melanurus* or *griscescens.*

12. **Metachirus nudicaudatus columbianus** *Allen.*

Three adult specimens, Buena Vista, near Bogotá (O'Connell).

These specimens agree very closely with *columbianus,* to which they are provisionally referred.

13. **Metachirus nudicaudatus antioquiæ** *Allen.*

One specimen, the type, Frijolera, Antioquia (Miller and Boyle). (Bull. XXXV, p. 83, 1916.)

14. **Philander laniger cicus** (*Bangs*).

One specimen, Tolima, near Bogotá (A. Maria).

15. **Chironectes minimus** (*Zimmermann*).

Five specimens: Juanchito and Palmira, 1 each (Miller and Richardson); Bull. XXXI, p. 74, 1912); Barbacoas, 1 (Richardson); Bagado, 1 (Kerr); Rio Frio, 1 (Miller).

BRADYPODIDÆ.

16. **Bradypus ephippiger** *Philippi.*

Four specimens: Rio San Jorge, 2 (Kerr; Bull. XXXI, p. 74, 1912); Barbacoas, 2 (Richardson).

17. **Bradypus ignavus** *Goldman.*

One specimen, skin only, Dabeiba (Miller and Boyle).

18. **Bradypus griseus** (*Gray*).

One specimen, Dabeiba (Miller and Boyle).

19. **Cholœpus hoffmanni** *Peters.*

Three specimens, Puerto Valdivia (Miller and Boyle).

20. **Cholœpus florenciæ** *Allen.*

Two specimens, Florencia, Caquetá district (Miller). (Bull. XXXII, p. 469, figs. 3, 9, 15, Sept. 25, 1913.)

21. **Cholœpus agustinus** *Allen.*

Two specimens, near San Agustin (Miller). (Bull. XXXII, p. 472, p. 470, figs. 4, 10, 16, Sept. 25, 1913.)

22. **Cholœpus andinus** *Allen.*

Two specimens, Salento (Miller). (Bull. XXXII, p. 472, figs. 6, 12, 18, Sept. 25, 1913.)

23. **Cholœpus capitalis** *Allen.*

Four specimens, Barbacoas (Richardson). (Bull. XXXII, p. 472, figs. 5, 11, 17, Sept. 25, 1913.)

MYRMECOPHAGIDÆ.

24. **Tamandua tetradactyla chiriquensis** *Allen.*

Three specimens: Bagado, adult male; Baudo, adult male (Kerr); Chicoral, Coello River (alt. 1800 ft.), adult female (Miller). Practically indistinguishable from the types and topotypes of *chiriquensis.*

25. **Cyclopes didactylus eva** *Thomas.*

One specimen, Muralla, Caquetá district, July 8 (Miller). (Compared with the type.)

26. **Cyclopes didactylus dorsalis** (*Gray*).

Two specimens, Puerto Valdivia (Miller and Boyle).

DASYPODIDÆ.

27. **Dasypus novemcinctus** *Linné.*

Seven specimens: Munchique, 1 (Bull. XXXI, p. 74, 1912); Salento, West Quindio Andes, 4 (Miller); Anolaima, 2 (Gonzales).

Perhaps referable to *Dasypus novemcinctus æquatorialis* Lönnberg (Arkiv för Zool., VIII, No. 16, p. 34, July 12, 1913), but the characters alleged as distinctive of *æquatorialis* are subject to so much individual variation that comparison of a single specimen from northern Ecuador with the type specimen of *D. novemcinctus,* as was made by Lönnberg, cannot be decisive.

TAYASSUIDÆ.

28. **Pecari crusnigrum** (*Bangs*).

One specimen, adult male, La Frijolera, Antioquia (Miller and Boyle). The coloration above is deep rich tawny, with a strong median black dorsal stripe, extending from tip of nose to rump.

CERVIDÆ.

29. **Mazama murelia** *Allen.*

One specimen, adult female, Muralla, Rio Bodoquera, Caquetá, July 13, 1912 (Miller). (Bull. XXXIV, p. 547, 1915.)

30. **Mazama zetta** *Thomas.*

Mazama tschudii Allen (not of Wagner), Bull. XXXI, p. 74, 1912.
Mazama zetta Allen, Bull. XXXIV, p. 544, 1915.

Two specimens, Gallera, July 2 (Miller).

31. **Mazama sheila** *Thomas.*

A fawn from La Palma (Miller) is provisionally referred to this species. (Bull. XXXIV, pp. 539, 545, 1915.)

Leporidæ.

32. **Sylvilagus salentus** *Allen.*

Sylvilagus (*Tapeti*) *salentus* Allen, Bull. XXXII, p. 476, Sept. 25, 1913.

One specimen, Salento (Miller).

33. **Sylvilagus fuscescens** *Allen.*

Sylvilagus (*Tapeti*) *fuscescens* Allen, Bull. XXXI, p. 75, 1912.

One specimen, Belen, Western Andes (Miller).

Sylvilagus fuscescens has now been compared with the material in the British Museum, and its nearest relationship is found to be with *S. andinus* (Thomas), but it differs from it widely (*cf.* this Bull., XXXII, p. 477, 1913).

34. **Sylvilagus boylei** *Allen.*

One specimen, La Playa, near Barranquilla. (Bull. XXXV, p. 84, 1916.)

Hydrochœridæ.

35. **Hydrochœrus hydrochœrus** *Linné.*

One specimen, adult male, Rio Frio (Miller).

Caviidæ.

36. **Cavia anolaimæ** *Allen.*

Two specimens, Anolaima (Gonzalez). (Bull. XXXV, p. 85, April 28, 1916.)

DASYPROCTIDÆ.

37. **Dasyprocta variegata chocoensis** *Allen.*

Dasyprocta variegata variegata ALLEN (not of Tschudi), Bull. XXXI, p. 76, 1912.
Dasyprocta variegata chocoensis ALLEN, Bull. XXXIV, p. 627, 1915.

Five specimens: Los Cisneros, 2 (Richardson); Rio Osculo (Batty), Baudo and Bagado (Kerr), 1 each.

38. **Dasyprocta fuliginosa candelensis** *Allen.*

Four specimens: La Candela, San Agustin, and Andalusia (Miller). (Bull. XXXIV, p. 625, 1915.)

39. **Dasyprocta fuliginosa columbiana** *Allen.*

Two specimens, Frijolera, Antioquia (Miller and Boyle). (Bull. XXXIV, p. 628, 1915.)

40. **Dasyprocta (Myoprocta) exilis milleri** *Allen.*

Myoprocta milleri ALLEN, Bull. XXXII, p. 477, Sept. 25, 1913.

Eleven specimens, Muralla (Miller).

Dasyprocta exilis Wagler [1] was based on a specimen obtained by Spix on the Rio Amazon, presumably near the mouth of the Rio Negro, which may be designated as the type locality. The type of Pocock's *Myoprocta pratti* [2] is said to have been brought "from the Amazons," and hence *M. pratti* has no definite type locality. It is doubtless referable to *D. exilis* of Wagler, which is represented in this Museum by a specimen collected by Leo E. Miller, on the Roosevelt Expedition, near the junction of the Rio Gy-Parana with the Rio Madeira.

41. **Agouti paca virgata** *Bangs.*

Two specimens: San José, 1 (Richardson; Bull. XXXI, p. 75, 1912); Baudo, 1, about one fourth grown (Kerr).

42. **Agouti paca taczanowskii** *(Stolzmann).*

Agouti paca (subs. indet.) ALLEN, Bull. XXXI, p. 76, 1912. La Florida.

Four specimens: La Florida, 1; La Guneta, 1 (Miller); Barbacoas, 2 (Richardson).

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[1] *Dasyprocta exilis* Wagler, Isis von Oken, 1831, p. 621. "Brasilia ad flumen Amazonum."

[2] Ann. and Mag. Nat. Hist. (8), VII, p. 110, July, 1913.

43. **Agouti paca** (near **sierræ** *Thomas*).

One specimen, a young female, Paramillo (alt. 12,500 ft.), Antioquia (Miller and Boyle).

This specimen belongs to the *sierræ* group, but further material will probably show that it is subspecifically separable from typical *sierræ* (type locality, Andes of Merida).

44. **Dinomys branickii** *Peters.*

One specimen, a flat skin without feet or tail, La Candela, Huila, altitude 6500 feet (Miller). Mr. Miller obtained this skin from the hunter who killed the animal, and he has no doubt of its having been taken near where the man lived, that is, at or near La Candela.

The type specimen of this species was taken by Jelski, according to Peters (Monatsb. k. p. Acad. Wissensch. Berlin, 1873, p. 552), in the mountains of Central Peru (altitude not given). Later Goelde (P. Z. S., 1904, II, p. 161) stated: "As matters now stand, it would be justifiable to suppose that the true home of *Dinomys* is not properly in the Peruvian Andes, and that the first specimen found there was merely a stray individual, and that its actual habitat may rather be located in the almost unexplored regions of the eastern slopes and tablelands of the Bolivian and Peruvian foothills bordering on Brazil, including geographically the headwaters of the Rivers Acre, Purús, and Juruá." However this may prove to be, the capture of the present specimen in the Eastern Andes of Colombia appears to confirm its mountain habitat, besides extending the range of the species far to the north of the point where it was originally discovered.

OCTODONTIDÆ.

45. **Prœchimys semispinosus semispinosus** (*Tomes*).

Thirty-five specimens,— 27 adult and 8 young: Florencia, Caquetá district, 18; Muralla, Caquetá district, 9 (Miller). Seven of the adults — about one fourth — are tailless.

The type locality of *Echimys semispinosus* Tomes, according to Thomas (on the back of label), is Gualaquiza, Ecuador, this being the specimen from which the skull was figured. This locality is in southeastern Ecuador on the "Rio S. Jago" (Sclater, P. Z. S., 1858, p. 450) probably the Rio Santiago of modern maps. Three specimens of this species were received "in spirits, all of which were females; one of them contained two young" (Tomes, P. Z. S., 1860, p. 267). Two of these specimens are now in the

British Museum, "evidently skinned out of spirit and much discolored," as stated on the labels. I omitted to examine the type skull figured by Tomes, but from an examination of Tomes's figure it is too adult to have belonged to either of these two skins, which are only about half-grown. They are indistinguishable in coloration and other features from specimens of corresponding age collected at Florencia and Muralla. The skin of the third specimen, doubtless the adult female mentioned by Tomes, and the one to which the figured skull belonged, has apparently been lost.

46. **Proechimys semispinosus calidior** *Thomas.*

Twenty-four specimens: San José, 14 (Richardson; Bull. XXXI, p. 76, 1912); Barbacoas, 5 (Richardson); Bagado and Andegada, 4 (Kerr); Nóvita Trail, 1 (Miller).

The latter, as well as the 14 specimens collected at San José by Richardson (as previously recorded, *l. c.*), differ quite appreciably in coloration from the specimens from the Caquetá district east of the Andes, the dorsal pelage being suffused with a brighter, yellowish rufous tint, and the median dorsal region is strongly washed with black, a feature not present in typical *semispinosus.* The tail is also much more hairy in *calidior.*

The series thus far obtained by our collectors extends the known range of *calidior* from the coast region of northern Ecuador northward to Baudo on the coast, and to Nóvita in the San Juan valley. Neither form has been taken at altitudes above 700 feet, and the fact that none have been taken at the many localities above this altitude where thorough collecting has been carried on would seem to indicate that these two forms have been for a long period geographically separated.

47. **Proechimys o'connelli** *Allen.*

Seven specimens: Villavicencio, 5 (O'Connell; Bull. XXXII, p. 479, Sept. 25, 1913); Barrigona, 2 (Gonzales).

48. **Hoplomys gymnurus** (*Thomas*).

Thirteen specimens: Barbacoas, 8; Buenavista, 1 (Richardson); Bagado, 2 (Kerr); Alto Bonito, 1; Puerto Valdivia, 1 (Miller and Boyle).

Compared with the type and other material in the British Museum, from Cachavi and St. Xavier, Ecuador, and with others from Rio Tanana, branch of the Rio San Juan, Chocó district, Colombia.

The spines develop early, forming part of the first pelage, as shown by specimens less than one fourth grown, in which the fulvous underfur was still wholly absent.

49. **Dactylomys dactylinus dactylinus** (*Desmarest*).

One specimen, adult female, Villavicencio (Fuertes). Total length, 689; head and body, 254; tail, 425; hind foot, 55.

This specimen greatly extends the known range of this genus from Nanta, at the mouth of the Rio Napo, northeastward to the headwaters of the western tributaries of the Rio Orinoco.

50. **Isothrix rufodorsalis** *Allen.*

A second specimen, in fine condition, has recently been received from the Sierra Nevada de Santa Marta, collected by M. A. Carriker. It agrees essentially with the type in every particular.

51. **Thrinacodus apolinari** *Allen.*

One specimen, Tomeque, near Bogotá (Apolinar Maria). (Bull. XXXIII, p. 387, pl. xxviii, 1914.)

HETEROMYIDÆ.

52. **Heteromys australis** *Thomas.*

Heteromys lomitensis ALLEN, Bull. Amer. Mus. Nat. Hist., XXXI, p. 77, April 19, 1912.

Twenty-five specimens: Las Lomitas, 3; Barbacoas, 5; Buenavista, Nariño, 4 (Richardson); Bagado, 1 (Kerr); Salento, 2; El Roble, 8 (Miller); Alto Bonito, 1; La Frijolera, 1 (Miller and Boyle).

The series of six specimens, from near sea level at St. Xavier, lower Cachivi River, northwestern Ecuador, on which *H. australis* Thomas was based, are all in abnormal pelage, being faded, greatly worn, dull brown instead of black, and spiny, lacking the full and soft overlying hairs present in the specimens on which *lomitensis* was founded. Yet a comparison of the present series, consisting partly of specimens from near the type locality of *australis,* leaves no doubt that the striking differences in coloration and character of the pelage between the two series are either quite accidental or merely seasonal. The contrast in coloration and pelage between the two is rarely more striking in the case of any two congeneric species, and as no hint was given in the description of *H. australis* of the worn and faded character of the pelage, it was quite natural to mistake specimens in fresh, unbleached and unworn condition for a quite distinct species. In size, cranial characters, and distributional range, there is nothing to suggest specific separation, so that *H. lomitensis* must be referred to *H. australis.*

53. **Heteromys anomalus** *Osgood.*

One specimen, Honda (O'Connell).

MURIDÆ.

54. **Mus musculus musculus** *Linné.*

Seven specimens, San José and Caldas (Richardson). (Bull. XXXI, p. 77, 1912.) Also numerous specimens, from near Bogotá (Gonzalez).

55. **Epimys rattus alexandrinus** (*Geoffroy*).

Thirty specimens: Barbacoas, 5 (Richardson); Bagado, 4 (Kerr); Noanama, Rio San Juan, 1 (Miller); San Agustin, 6 (Miller); Buenavista, near Bogotá, 3 (O'Connell); vicinity of Bogotá, a large series (Gonzalez). Also a pure albino from Bogotá (A. Maria).

The specimens from the coast region are the typical white-bellied phase; those from the interior have plumbeous bellies and darker upperparts than typical *alexandrinus*, being intermediate between *alexandrinus* and *rattus*.

56. **Reithrodontomys milleri** *Allen.*

Twenty-five specimens: Munchique and Cocal, 17 (Miller; Bull. XXXI, p. 77, 1912); San Agustin, Huila, 1; La Guneta, 1; El Roble, 6 (Miller).

The Central Andes specimens are darker on the back and smaller than the type series, but they are also apparently younger. All but two are without skulls; the single skull complete enough for satisfactory comparison is adult and confirms, as far as it has weight, the smaller size of the Central Andes series as compared with the original series from the Western Andes, two degrees of latitude further south.

57. **Reithrodontomys söderströmi** *Thomas.*

Four specimens, Valle de las Papas (alt. 10,000 ft.), Central Andes, Huila (Miller).

These have been compared with the type and 12 topotypes of the species from Quito in the British Museum, from which they do not essentially differ.

The type of *söderströmi* agrees with the description, but differs from the topotype series in having the tip of the tail and the metapodials white, which are not so in the topotypes, in which the metapodials are dark medially and the tip of the tail is not white-tipped. The original description is therefore highly misleading.

58. **Rhipidomys mollissimus** *Allen.*

One specimen, Miraflores (Miller). (Bull. XXXI, p. 78, 1912.)

This species has no close relationship with *R. fulviventer* Thomas, as formerly suggested (*l. c.* p. 79), but is much nearer *R. pictor* Thomas, which is, however, brighter colored and much smaller than *mollissimus,* and has the feet flesh-colored instead of black.

59. **Rhipidomys goodfellowi** *Thomas.*

One specimen, adult female, Florencia (alt. 675 ft.), Caquetá (Miller).

60. **Rhipidomys cocalensis** *Allen.*

Four specimens, Cocal (Miller). (Bull. XXXI, p. 79, 1912.)

This species has been compared with the type and topotype of *R. latimanus* (Tomes), to which it is related, but *cocalensis,* as shown by the skulls, is much larger than *latimanus,* the total length of the skull in *latimanus* being 31 mm. and the greatest breadth 16 mm., as compared with 35 mm. and 19 mm. for the same measurements in *cocalensis.*

61. **Rhipidomys similis** *Allen.*

Six specimens, Cocal (Miller). (Bull. XXXI, p. 79, 1912.)

This proves to be too unlike any of the other described species of the genus to require comparison with them.

62. **Rhipidomys quindianus** *Allen.*

Two specimens, El Roble, Central Andes (Miller). (Bull. XXXII, p. 600, 1913.)

63. **Rhipidomys caucensis** *Allen.*

Three specimens, Munchique, Western Andes (Miller). (Bull. XXXII, p. 601, 1913.)

64. **Œcomys bicolor** (*Tomes*).

Six specimens: Andalucia, 1; Florencia, 5 (Miller). Florencia (altitude 675 feet) is at the eastern base of the Andes, in the Department of Caquetá.

65. **Thomasomys laniger** (*Thomas*).

Three specimens, Chipaque, Eastern Andes (O'Connell).

66. **Thomasomys cinereiventer** *Allen.*

Sixty specimens: Popayan (10,300 ft.), 22; and Cocal (6000 ft.), 8 (Miller; Bull. XXXI, p. 80, 1912); Alamaguer (10,300 feet), 4; La Guneta, West Quindio Andes (10,300 feet), 11; Santa Isabel, Quindio Andes (12,700 feet), 5; Andalucia (7000 feet), 8 (Miller); Sta. Elena and Paramillo, 1 each (Miller and Boyle).

This species presents a general resemblance to *T. kalinowskii,* from Vitoc, Central Peru, so far as can be determined by comparison with the type of the latter, formerly preserved for a long time in spirits. But the type skull presents well-marked differences from the skulls of *cinereiventer* in its depressed instead of straight rostrum and shorter and narrower palatal foraminæ. The two species are similar in size and probably also in coloration.

67. **Thomasomys popayanus** *Allen.*

Twenty-one specimens: Popayan, Western Andes, 14 (Miller; Bull. XXXI, p. 81, 1912); Santa Isabel, Quindio Andes (12,000 feet), 2; Salento, 1 (Miller); Sta. Elena and Paramillo, each 1 (Miller and Boyle).

As said in the original description (*l. c.*), this species most resembles *T. princeps* (Thomas), from the plains of Bogotá. A direct comparison of *T. popayanus* with the type and five topotypes of *T. princeps* shows that *princeps* is a much larger species and much more intensely colored both above and below, the upperparts being rufous brown, and the lower parts more strongly ochraceous. There are no external measurements for the *princeps* specimens, except for the hind foot, which without the claws is as long or longer than the hind foot of *popayanus* with the claws, and proportionately broader. The skull is broader and more massive, the supraorbital ridges are more heavily developed, and the lower jaw is much more robust and heavier, in accordance with the larger size of the animal as indicated by the larger hind feet and longer tail.

T. popayanus agrees well with *T. aureus* (Tomes) in coloration but is much smaller, with weaker dentition and slight cranial differences. It is probably only a subspecies of the *T. aureus* group, to which *T. princeps* seems also referable as a subspecies.

68. **Neacomys pusillus** *Allen.*

One specimen, San José, Cauca (Richardson). (Bull. XXXI, p. 81, 1912.)

Three specimens (Miller) from El Roble, Nov. 9–11, without skulls agree in size and coloration with this species, to which they are provisionally referred.

69. **Neacomys spinosus** (*Thomas*).

Four specimens: La Murelia, Caquetá, July 11–19 (Miller).

70. **Oryzomys pectoralis** *Allen.*

One hundred and twenty-six specimens, all from the Western Andes, except 10 from Miraflores (Richardson), as follows: Cocal, 10; Gallera, 2; Munchique, 45; crest of Western Andes, west of Popayán, 30; Güengüe, 1 (Miller); San Antonio, 10; Las Lomitas 1 (Richardson; Bull. XXXI, pp. 83–85, 1912), altitudes 4000–10,340 feet; El Eden, East Quindio Andes, 1; West Quindio Andes, above Salento, 3; La Guneta, West Quindio Andes, 1; El Roble, Quindio Andes, 2 (Miller); Sta. Elena, 8; La Frijolera, 6 (Miller and Boyle).

Another specimen (without skull) from Andalucia, Huila, Eastern Andes, altitude 10,300 feet (Miller), is provisionally referred to this species.

As stated in the original description (this Bulletin, XXXI, p. 85, April 19, 1912), *O. pectoralis* is related to *O. albigularis* (Tomes), but it is much larger, as I have since confirmed by direct comparison with a large series of *O. albigularis* in the British Museum from Pallatanga, Ecuador, the supposed type locality (type not known to be in existence). *O. keaysi* Allen, from southern Peru, is a member of the same group, but usually wholly lacks the pectoral white patch.

Mr. Osgood has made (Field Mus. Nat. Hist., Zool., X, No. 12, p. 159, April 20, 1914) a pronouncement on the relations of this and other species of *Oryzomys* recently described by me which I am quite unwilling to accept as final.

71. **Oryzomys helvolus** *Allen.*

Six specimens, Villavicencio and Buenavista, near Bogotá (O'Connell). (Bull. XXXII, p. 597, 1913.)

72. **Oryzomys o'connelli** *Allen.*

Four specimens: Buenavista, Eastern Andes, 2 (O'Connell; Bull. XXXII, p. 597, 1913); Rio Guatequi, 2 (A. Maria).

73. **Oryzomys vicencianus** *Allen.*

Two specimens, Villavicencio, eastern base of Eastern Andes (O'Connell). (Bull. XXXII, p. 598, 1913.)

74. **Oryzomys mureliæ** *Allen.*

Oryzomys incertus Allen, Bull. XXXII, p. 598, 1913; *Oryzomys mureliæ* Allen, Bull. XXXIV, p. 630, 1915, to replace *incertus*, preoccupied.

One specimen: La Murelia (= Muralla), Caquetá (Miller).

75. **Oryzomys palmiræ** *Allen.*

Thirty-six specimens: Palmira, 1; Cocal, 1; crest of the Andes west of Popayan, 1; Miraflores, 5; Las Lomitas, 6 (Miller; Bull. XXXI, p. 83, 1912); Rio Frio, 17; Salencio, Nóvita Trail, 3; near San Agustin, Huila, 1; La Candela, Huila, 1 (Miller).

76. **Oryzomys perenensis** *Allen.*

Eight specimens: Florencia, Caquetá (altitude 675 feet), 5; Muralla, Caquetá (altitude 600 feet), 3 (Miller).

This series agrees satisfactorily with three topotypes of *O. perenensis* from Perené, Peru (altitude 800 m.), collected by P. O. Simons. These localities are both in the Amazonian watershed.

77. **Oryzomys gracilis** *Thomas.*

Two specimens: Barbacoas, 1 (Richardson); La Frijelora, 1 (Miller and Boyle).

The Barbacoas specimen is doubtfully referred to this species, although it agrees satisfactorily with it in size and coloration; the other is practically a topotype.

78. **Oryzomys auriventer** *Thomas.*

Three specimens: Santa Isabel, Quindio Andes, 2; Salento, 1 (Miller).

These specimens closely resemble in coloration the type and topotype (in British Museum, from central Ecuador) of this species, but are somewhat smaller and also younger. They are, however, referred to it with some reservation.

79. **Oryzomys barbacoas** *Allen.*

Two specimens, Barbacoas. (Bull. XXXV, p. 85, April 28, 1916.)

80. **Oryzomys balneator** *Thomas.*

One specimen, young adult, Ricuarte, southwestern Colombia near Ecuador boundary (Richardson). Provisionally referred to this species.

81. **Oryzomys (Oligoryzomys) munchiquensis** *Allen.*

Twenty-three specimens: Munchique, Cocal, and La Florida, Western Andes (Miller; Bull. XXXI, p. 85, 1912); Ricuarte, 2 (Richardson); La Sierra, 2; La Palma, 1; Salento, 1; Rio Toché, 2 (Miller).

This species closely resembles *O. stolzmanni* in coloration. Six adults measure: Total length, 179 (170–200); head and body, 76.3 (69–85); tail, 103 (90–115); hind foot *with claws*, 20.6 (20–22). Six adults of *O. stolzmanni* (in British Museum) measure: Total length, 215 (205–225); head and body, 91.6 (90–98); tail, 122 (115–135); hind foot *without claws*, 24.3 (22–28). The hind foot in *munchiquensis, with the claws* averages 4 mm. shorter than in *stolzmanni without* the claws, and is proportionately smaller in all other measurements.

82. **Oryzomys (Oligoryzomys) fulvirostris** *Allen.*

Eighteen specimens: Gallera and Munchique, 3 (Miller; Bull. XXXI, p. 86, 1912); Salento, 2; Rio Toche, 10; El Roble, 2; Valle de las Papas, Central Andes, 1 (Miller). Altitudes 6800–7200 feet, with one (Valle de las Papas) 10,000 feet.

This is a member of the *O. dryas* group, near *O. humilior*, but much paler than either *humilior* or *dryas*.

83. **Oryzomys (Oligoryzomys)** near **tenuipes** *Allen.*

Two specimens: Lumapaz, near Bogotá (A. Maria).

These specimens are near *Oryzomys* (*Oligoryzomys*) *tenuipes* Allen from Merida, but with the underparts clear white instead of pale buff as in *tenuipes*.

84. **Melanomys affinis affinis** *Allen.*

Oryzomys (*Melanomys*) *obscurior affinis* Allen, Bull. XXXI, p. 88, 1912.
Melanomys affinis affinis Allen, Bull. XXXII, p. 539, 1913.

Fourteen specimens, coast region of southwestern Colombia (Richardson).

85. **Melanomys affinis monticolor** *Allen.*

Melanomys affinis monticolor Allen, Bull. XXXII, p. 540, 1913.
Oryzomys (*Melanomys*) *obscurior* Allen (not of Thomas), Bull. XXXI, p. 87, 1912.

Thirty-six specimens: Gallera and Cocal, west slope of Western Andes (Miller).

86. **Melanomys phæopus phæopus** (*Tomes*).

Oryzomys (*Melanomys*) *phœopus* Allen, Bull. XXXI, p. 87, 1912.
Melanomys phœopus phœopus Allen, Bull. XXXII, p. 541, 1913.

Twenty-nine specimens: Munchique, La Florida (Miller); Las Lomitas, and Caldas (Richardson); Western and Central Andes.

87. **Melanomys phæopus vallicola** *Allen.*

Twenty-four specimens, Rio Frio, Cauca Valley (Miller). (Bull. XXXII, p. 544, 1913.)

88. **Melanomys phæopus tolimensis** *Allen.*

Five specimens, Rio Toché (Miller). (Bull. XXXII, p. 545, 1913.)

89. **Melanomys lomitensis** *Allen.*

Six specimens, Las Lomitas, Western Andes (Richardson). (Bull. XXXII, p. 545, 1913.)

90. **Melanomys buenavista** *Allen.*

Seven specimens, Buenavista, Eastern Andes (O'Connell). (Bull. XXXII, p. 547, 1913.)

91. **Melanomys obscurior** (*Thomas*).

Ten specimens: La Frijolera, 8; Alto Bonito, 2 (Miller and Boyle).

These specimens are practically topotypes, Concordia, the type locality being only a few miles away from these localities and in the same faunal zone.

Seven adults: Total length, 217 (207–230) mm.; tail vertebræ, 95 (94–97); hind foot, 24.7 (24–25).

92. **Æpeomys fuscatus** *Allen.*

Twenty specimens: San Antonio, 12 (Richardson; Bull. XXXI, p. 89 1912); El Roble, Quindio Trail (7200 ft.), 6; Salento, Quindio Trail (7000 ft.), 2. These localities are about 70 miles north of San Antonio, the type locality of the species.

On direct comparison of the large type series of *Æ. fuscatus* with the type of *Æ. vulcani*, west slope of Mt. Pichincha at an altitude of 12,000 feet, *fuscatus* proves to be smaller and less brown than *vulcani*, and the anterior edge of the zygomatic plate is more produced and the palate itself is much broader. The skull is much smaller, the total length only equalling the length of the skull in *vulcani* to the parieto-occipital suture (the type skull of *vulcani* lacks the occipital part), and the toothrow is correspondingly shorter and narrower. The type skull of *fuscatus* differs slightly from the skulls of the cotypes, showing a closer resemblance to the type skull of *vulcani* than any of the other skulls in the original type series of ten in the form of the zygomatic plate. On comparison with *Æ. lugens* Thomas, it was found that *lugens* and *vulcani* resemble each other more than either does *fuscatus*.

93. **Microxus affinis** *Allen.*

Two specimens: San Antonio, type (Richardson; Bull. XXXI, p. 89, 1912); Sta. Elena, 1 (Miller and Boyle).

On comparison of the type of *M. affinis* with the type and five other Bogotá specimens of *M. bogotensis* Thomas, *affinis* proves to be much larger than *bogotensis,* with the superficial coloration (hair-tips) olive instead of rufescent. In coloration *M. affinis* is nearer *M. mimus* Thomas, from which it differs in much smaller size, *affinis* having a total length of 160 mm. while two adult specimens of *mimus* have a total length respectively of 184 and 187, and a correspondingly greater length of tail and hind foot.

94. **Microxus bogotensis** (*Thomas*).

Four specimens, Rio Toché (Miller).

These specimens all lack skulls, but are identified with little hesitation as *Microxus bogotensis* on the basis of the external characters, especially the size and the rufescent tone of the hair-tips of the upperparts.

95. **Akodon tolimæ** *Allen.*

Thirty-eight specimens: Rio Toché, Central Andes (Miller). (Bull. XXXII, p. 480, 1913.)

96. **Akodon chapmani** *Allen.*

Three specimens: Chipaque and Buenavista, Eastern Andes (O'Connell). (Bull. XXXII, p. 600, 1913.)

97. **Zygodontomys brunneus** *Thomas.*

One specimen, Andalucia, June 12 (Miller).

98. **Zygodontomys griseus** *Allen.*

One specimen, El Triunfo, Magdalena Valley (O'Connell). (Bull. XXXII, p. 599, 1913.)

99. **Zygodontomys fraterculus** *Allen.*

Two specimens: Chicoral, Tolima (Miller). (Bull. XXXII, p. 599, 1913.)

100. **Tylomys miræ** *Thomas.*

Six specimens, the oldest a young adult, the others one third to two thirds grown: Barbacoas, 5; Buenavista, Dept. Nariño, 1 (Richardson).

The coloration in this series is a darker, clearer gray above and a clearer white below than in the type and other specimens from northern Ecuador, which are all old adults in somewhat worn and apparently more or less faded pelage.

101. **Nectomys magdalenæ** *Thomas.*

A half-grown specimen from Buenavista, near Bogotá (O'Connell), too young for satisfactory determination, is provisionally referred to this species.

102. **Nectomys garleppei** *Thomas.*

Seven specimens: near San Agustin, Huila, 3; Andalucia, Huila, 2; Florencia, Caquetá, 2 (Miller).

SCIURIDÆ.

103. **Microsciurus similis similis** *Nelson.*

Seven specimens: San Antonio, 1 (Richardson); Cocal, 2, Gallera, 2, Salencio, 2 (Miller). (Bull. XXXI, p. 92, 1912; XXXIII, p. 153, 1914; XXXIV, p. 192, 1915.)

104. **Microsciurus similis fusculus** *Thomas.*

Three specimens: Juntas de Tamaná, 1 (Miller); Baudo, 2 (Kerr). (Bull. XXXIII, p. 154, 1914.)

105. **Microsciurus otinus** *Thomas.*

Seven specimens: Puerto Valdivia, 3, Alto Bonito, 4 (Miller and Boyle). (Bull. XXXIV, p. 307, 1914.)

106. **Microsciurus mimulus** *Thomas.*

Five specimens: Barbacoas, 5 (Richardson). Bull. XXXIII, p. 58, 1914.)

107. **Microsciurus palmeri** *Thomas.*

Four specimens: Nóvita, 2, San José, 1, Buenavista, Nariño, 1 (Miller and Richardson). (Bull. XXXIII, p. 160, 1914.)

108. **Microsciurus florenciæ** *Allen.*

Four specimens: Florencia, 2, Muralla, 2 (Miller). (Bull. XXXIII, p. 164, 1914.)

109. **Leptosciurus pucheranii pucheranii** (*Fitzinger*).

Seven specimens: near Bogotá, 2 (Gonzales); Fusugasugá, 3 (O'Connell); La Candela, 1, Andalucia, 1 (Miller). (Bull. XXXIV, p. 200, 1915.)

110. **Leptosciurus pucheranii medellinensis** (*Gray*).

Seven specimens: Barro Blanco, 4, Santa Elena, 3 (Miller and Boyle). (Bull. XXXIV, p. 307, 1915.)

111. **Leptosciurus pucheranii salentensis** (*Allen*).

Fifteen specimens: El Roble, 2; Laguneta, 2; Miraflores, 2; Palmira, 1 (Miller); La Frijolera (near Puerto Valdivia), 8 (Miller and Boyle). (Bull. XXXIII, p. 587, 1914; XXXIV, pp. 203, 307, 1915.)

112. **Leptosciurus pucheranii caucensis** (*Nelson*).

Three specimens: Miraflores, 2; near Palmira, 1 (Richardson). (Bull. XXXI, p. 91, 1912; XXXIV, p. 203, 1915.)

113. **Mesosciurus hoffmanni hoffmanni** (*Peters*).

Forty-four specimens: San Antonio, 9; Miraflores, 9; Las Lomitas, 2 (Richardson); Cerro Munchique, 8; Gallera, 2; La Florida, 2; La Sierra, 7; El Eden, 5 (Miller). (Bull. XXXI, p. 90, 1912; XXXIV, p. 217, 1914.)

114. **Mesosciurus hoffmanni quindianus** (*Allen*).

Twenty specimens: Rio Frio, 6; Salencio, 1; Salento, 2; Laguneta, 5 (Miller); Barro Blanco, 3; Santa Elena, 2; Malena, 1 (Miller and Boyle). (Bull. XXXIII, p. 587, 1914; XXXIV, pp. 222, 308, 1915.)

115. **Mesosciurus hoffmanni hyporrhodus** (*Gray*).

Twenty-one specimens: Fusugasugá, 7; Quitame, 4 (O'Connell); Panama Largo, 3; Monte Redundo, 1; Anolaima, 6 (Gonzales). (Bull. XXXIV, p. 223, 1915.)

116. **Mesosciurus griseimembra** (*Allen*).

Five specimens: Buenavista, 4 (O'Connell); Andalucia, 1 (Miller). (Bull. XXXIII, p. 589, 1914; XXXIV, p. 233, 1915.)

117. **Mesosciurus candalensis** (*Allen*).

Eleven specimens: La Candela, 8; La Palma, 3 (Miller). (Bull. XXXIII, p. 590, 1914; XXXIV, p. 235, 1915.)

118. **Mesosciurus gerrardi milleri** (*Allen*).

Fourteen specimens: Cocal, 2 (Miller); Ricuarte, 4; Barbacoas, 8 (Richardson). (Bull. XXXI, 91, 1913; XXXIV, p. 241, 1915.)

119. **Mesosciurus gerrardi salaquensis** (*Allen*).

Ten specimens: Rio Salaqui, 3 (Kerr); Alto Bonito, 3; Dabeiba, 4 (Miller and Boyle). (Bull. XXXIII, p. 594, 1914; XXXIV, pp. 245, 309, 1915.)

120. **Mesosciurus gerrardi baudensis** *Allen*.

Four specimens: Baudo, 2; Bagado, 1 (Kerr); Juntas de Tamaná, 1 (Miller). Bull. XXXIV, p. 308, 1915.)

121. **Mesosciurus gerrardi valdiviæ** *Allen*.

Twelve specimens: Puerto Valdivia, 6; Frijolera, 6 (Miller and Boyle). (Bull. XXXIV, p. 309, 1915.)

122. **Mesosciurus saltuensis magdalenæ** *Allen*.

Two specimens: Banco, near mouth of Rio Cauca (O'Connell). (Bull. XXXIII, p. 593, 1914; XXXIV, p. 251, 1915.)

123. **Urosciurus igniventris igniventris** (*Wagner*).

Five specimens: La Florencia, 4, La Murelia, 1 (Miller). (Bull. XXXIV, p. 271, 1915.)

124. **Urosciurus igniventris tœdifer** (*Thomas*).

Two specimens: Buenavista, (O'Connell; Bull. XXXIV, p. 272, 1915); Rio Lengupa, near Bogotá, (A. Maria).

MUSTELIDÆ.

125. **Mustela affinis affinis** *Gray*.

Mustela aureoventris GRAY, Proc. Zool. Soc. London, 1865, p. 115 (part, only the New Grenada specimen).

Mustela affinis GRAY, Ann. and Mag. Nat. Hist. (4), XIV, p. 375, Nov., 1874. New Grenada.

Mustela affinis affinis ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, pp. 98, 99, 100. Type locality fixed as Bogotá, Colombia.

Five specimens, vicinity of Bogotá.

In my paper on 'The Neotropical Weasels' I designated (*antea*, p. 99) Bogotá, Colombia as the type locality of Gray's *Mustela affinis*, and on page 104 of the same paper expressed the opinion that Gray's second specimen of his *Mustela aureoventris*, from "New Grenada (Fraser)," later became the type of his *M. affinis*. In a footnote to p. 99 of my above-cited paper I stated, on the authority of Oldfield Thomas of the British Museum that the type of *M. affinis* was still extant, and that I hoped soon to have his opinion as to whether my assumptions were well founded. His kind reply was received too late for use in my paper on the Neotropical weasels, but it is so important and conclusive as to the facts in the case that I take the liberty of inserting it here. He writes (*in litt.* of date April 10, 1916): "You are no doubt correct in saying that Gray's 2d specimen of *M. aureiventris* from New Grenada, was afterwards the type of his *affinis*. His reference to 'Fraser' is evidently a mistake, as the animal is registered as 'Purchased of Stevens,' and Fraser was never near New Grenada.

"At about the same time a number of birds were purchased of Stevens, labelled 'Bogotá,' and this may I think be taken as the true locality. But I do not know who the actual collector was, as Stevens was only a London dealer."

126. **Mustela affinis costaricensis** *Goldman*.

Putorius macrurus ALLEN (not of Taczanowski), Bull. Am. Mus. Nat. Hist., XXXI, p. 92, April 19, 1912. Munchique and Miraflores.

Mustela affinis costaricensis ALLEN, *ibid.*, XXXV, p. 101, April 28, 1916.

Five specimens: Munchique, 1; Miraflores, 1 (Miller); Sta. Elena, 2; Barra Blanco, 1 (Miller and Boyle).

127. **Tayra barbara barbara** (*Linné*).

Three specimens: Barrigona (near Bogotá), 1 (Gonzales); Puerto Valdivia, Antioquia, 2 (Miller and Boyle).

The Valdivia specimens are both males (one an old adult with the cranial sutures obliterated by ankylosis, the other younger with the fronto-maxillary and nasal sutures still open), taken on the same date at the same locality, yet they differ notably in the texture of the pelage and in coloration. The pelage in the younger animal is much softer and longer than in the other. Both are intense black except on the head and top and sides of the neck, where in the younger animal the color is brownish gray varied with black-tipped hairs; in the other these parts are golden brown from the anterior base of the ears nearly to the shoulders, the face gray varied with black-tipped hairs. In the younger specimen the yellow spot on the lower fore neck is pale and reduced to a small circular area about 10 mm. in diameter; in the other it is deep yellow, large, and triangular in outline, and about 35 mm. long and about the same in breadth on the lower border.

The collector's measurements are, respectively, total length, old ♂ 1035, young ♂ 1020 mm.; head and body, 620, 590; tail vertebræ, 430, 415. Skull, total length, old ♂ 120, young ♂ 116; condylobasal length, 115, 112; zygomatic breadth, 69, 64; interorbital constriction, 26, 22.5; postorbital processes, 34, 31; postorbital constriction, 21, 23; breadth of braincase, 53, 52; mastoid breadth, 45, 49; maxillary toothrow, 23, 23.2; carnassial, 9 × 7.3, 9 × 7.5.

128. **Conepatus mapurito** (*Gmelin*).

Two specimens, adult male and female, Balcillas, near Bogotá (Gonzales).

PROCYONIDÆ.

129. **Nasua nasua candace** *Thomas.*

Nasua quichua ALLEN, Bull. XXXI, p. 93, 1912. Not *N. quichua* Thomas.

Six specimens: Salento, 4; Popayan, 1; Cali, 1 (Miller); Subia, near Bogotá, 1 (Gonzales).

The Subia specimen is doubtfully referred here; it doubtless represents Thomas's recently described *Nasua judex* from "Bogotá." The others conform to the description of *N. candace* and geographically are referable, judging by other groups of similar distribution.

130. **Nasua olivacea olivacea** *Gray.*

One specimen, skin without skull, Anolaima, near Bogotá (Gonzales).

131. **Nasua olivacea lagunetæ** *Allen.*

Eight specimens, Salento district (Miller). (Bull. XXXII, p. 483, 1913.)

132. **Bassaricyon medius** *Thomas.*

Three specimens: Gallera, 2 (Miller; Bull. XXXI, p. 93, 1912); Puerto Valdivia, 1 (Miller and Boyle).

133. **Potos flavus tolimensis** *Allen.*

Four specimens (skins only): Giradot, Tolima, 1 (Chapman; Bull. XXXII, p. 481, 1913); Dabeiba, 3 (Miller and Boyle).

134. **Potos flavus meridensis** *Thomas.*

Two specimens, Fusugasugá, Eastern Andes (O'Connell).

135. **Potos flavus caucensis** *Allen.*

Seven specimens: San Antonio, 3, practically topotypes (Richardson; Bull. XXXI, p. 93, 1912); San Agustin, 2 (Miller); Bogado, 2 (Kerr).

FELIDÆ.

136. **Panthera onca** (*Linné*).

A beautiful jaguar skin was obtained by Mr. L. A. Fuertes, who accompanied Dr. Chapman on his 1913 expedition to the Eastern Andes as artist, which through his kindness I have had opportunity to examine. It was taken at Villavicencio, at the eastern base of the Eastern Andes (alt. 1500 ft.). In comparison with skins from Corumbá, Matto Grosso, it is very pale, the ground color being much lighter and the black markings much more restricted in area. The median dorsal band from the middle of the back to the base of the tail (beginning at the posterior border of the thoracic region) consists of a double row of long narrow black spots, as in one of the Corumbá specimens, but the adjoining lateral band on either sides has the circular spots open and less heavy than in Corumbá skins.

137. **Oncoides pardalis æquatorialis** (*Mearns*).

Two specimens: 1 adult male, skin and skull, Caquetá district, Colombia (Miller); 1 young male, skin and skull, Las Pabas, Cauca, Colombia (Batty).

Collector's measurements of the adult male (No. 33895): Total length, 1200 mm.; tail vertebræ, 350; hind foot, 160. Skull measurements: Total length, 142; condylobasal length, 132; zygomatic breadth, 94; interorbital breadth, 26.4; postorbital breadth, 32; breadth of braincase, 52; length of nasals on midline, 31; on outer border, 37; length of maxillary toothrow, 30.6; upper carnassial, 15 × 7.4.

The young male, about two thirds grown, still retains the greater part of the milk dentition; the canines and carnassials are just breaking through the alveoli. As in other young ocelots, the pelage is longer and softer than in adults and very different in color, the ground color of the sides, limbs and tail being white, and on the back posterior to the shoulders fulvous or mixed fulvous and white; shoulders, nape and head yellowish tawny. The dark markings throughout are intense black and sharply defined. A skin at this stage, *without the skull*, might readily be considered as belonging to a different species from the adult. That young specimens of the *pardalis* group differ markedly in color from the adults of the same subspecies, even when nearly full grown, is shown to be true of *O. p. mearnsi*, *O. p. sanctæmartæ*, and *O. p. albescens*.

Oncoides pardalis æquatorialis in coloration closely resembles in a general way *O. p. mearnsi* of Central America (Panama to Nicaragua), but the tawny color of the upperparts is deeper and more rufous, and extends much lower on the sides of the body. Specimens from western Colombia agree closely with Ecuador specimens, as would be expected, the type locality of *æquatorialis* being in northwestern Ecuador.

138. **Margay tigrina elenæ** *Allen.*

One specimen, Santa Elena, Antioquia (Miller and Boyle). (Bull. XXXIV, p. 631, 1915.)

139. **Margay caucensis** *Allen.*

One specimen, skin only, Las Pabas, near San Antonio (Batty). (Bull. XXXIV, p. 631, 1915.)

140. **Margay tigrina wiedi** (*Schinz*).

Two specimens: 1 adult male, skin and skull, Florencia (alt. 1000 ft.); 1 adult skin without skull, sex (♀ ?) not indicated, Andalucia (Miller).

External measurements, total length, ♂ 1030, ♀ ? 800; tail, ♂ 420, ♀ ? 300; hind foot, ♂ 120, ♀ ? 110. Skull of male (No. 33894), total length, 99; condylobasal length, 96; zygomatic breadth, 63; interorbital breadth, 19; postorbital breadth, 35; breadth of braincase, 45.5; length of nasals on midline, 16.5, on border, 21; length of maxillary toothrow, 22.5; upper carnassial, 12.2 × 6.

These two specimens do not seem to be separable from a specimen of *wiedi* taken at Urucum, Matto Grosso, Brazil (Roosevelt Exped.). Further material, however, may show that *wiedi* of Espirito Santo, Brazil, which is the type region of the species,[1] may be different from the Matto Grosso specimens.

141. **Herpailurus jaguarundi** (*Fischer*).

Three specimens, hunter's skins: Popayan, 1 (Miller; Bull. XXXI, p. 93, 1912); near Bogotá, 2. One of the latter is in the gray phase, the other in the red phase; both are very dark for their respective phases.[2]

CANIDÆ.

142. **Cerdocyon thous** (subsp. indet.).

Three specimens: a flat skin without skull, from near Bogotá (P. G. Howes); 2 young, about a week old, from Fusugasugá (G. K. Cherrie).

No other canid is included in the present large collection of mammals from Colombia.

SORICIDÆ.

143. **Cryptotis thomasi** (*Merriam*).

Two specimens, Paramo de Bogotá (A. Maria).

The bats collected on the recent American Museum expeditions to northern South America (about 250 specimens) have been identified by direct comparison with material in the United States National Museum. I am greatly indebted to Mr. Gerrit S. Miller, Jr., Curator of Mammals at the National Museum, for valued assistance in their determination.

EMBALLONURIDÆ.

144. **Rhynchiscus naso** (*Wied*).

Thirteen specimens: Nóvita, Rio San Juan, 5; La Murelia (=Muralla), Caquetá district, 8 (Miller).

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[1] In my second paper on mammals from Nicaragua (this Bulletin, XXVIII, pp. 108, 109, April 30, 1910) two specimens of cats were left unidentified, an adult male from Volcan de Chinandega (No. 28957) and an adult female from Matagalpa (No. 29596). I now find that they represent a form of the *Margay wiedi* group, allied to if not identical with *M. tigrina oncilla* (*Felis pardinoides oncilla* Thomas), the type locality of which is Volcan de Irazú, Costa Rica.

My *Felis carrikeri* (this Bull., XX, p. 47, Feb. 29, 1904) is probably a melanism of some form of *Margay tigrina*, perhaps of *Felis pardinoides oncilla* Thomas.

[2] I have long been convinced that *Felis eyra* and *F. jaguarundi* (auct.) were merely color phases of the same species. I find that Matschie held the same view as early as 1895 (S. B. Gesell. Naturfors. Freunde Berlin, Dec. 1895, p. 196).

NOCTILIONIDÆ.

145. **Dirias zaparo** (*Cabrera*).

One specimen, Noanoma, Rio San Juan, Dec. 31 (Miller). Agrees satisfactorily in size and coloration with Cabrera's description of the type from the upper Napo River. Much larger and very different in color from the type of *Noctilio* [*Dirias*] *minor* Osgood, with which it has been compared.

PHYLLOSTOMIDÆ.

146. **Micronycteris megalotis megalotis** (*Gray*).

Two specimens, Anolaima (alt. 7000 ft.), near Bogotá (O'Connell).

147. **Phyllostomus hastatus panamensis** *Allen*.

Ten specimens, Nóvita, Rio San Juan, Dec. 25 (Miller). All are the dark brown phase. Forearm, 90 (88–93); third metacarpal, 78 (76–80).

148. **Phyllostomus hastatus caucæ** *Allen*.

Five specimens (skins without skulls), Rio Frio (alt. 3500 ft.), Nov. 29 (Miller). All are the red phase. Forearm, 91.8 (91–92); third metacarpal, 83 (81–84).

149. **Glossophaga soricina soricina** (*Pallas*).

Seven specimens, Rio Frio (alt. 3500 ft.), Nov. 29 – Dec. 1 (Miller).

150. **Glossophaga apolinari** *Allen*.

Five specimens, Boqueron de San Francisco, near Bogotá (A. Maria). (Bull. XXXV, p. 86, 1916.)

151. **Hemiderma perspicillatum** (*Linné*).

Sixty-two specimens: Rio Frio, 10 (Miller); Andagada, 3 (Kerr); Salento, 7; Salencio, 2; near San Agustin, 15; Andalucia, 2; Muralla, 16 (Miller); Sta. Elena, 10; Barro Blanco, 1; Puerto Valdivia, 3; La Frijolera, 1; La Playa (near Barranquilla, 2 (Miller and Boyle). The collecting dates cover nine months of the year.

The Rio Frio specimens are larger and redder than those from the localities further south (Muralla, San Agustin and Andalucia), but for the present it seems best to use *Hemiderma perspicillata* as a blanket name for all the specimens from Colombia.

152. **Uroderma bilobatum** *Peters.*

Two specimens: Barbacoas, 1 (Richardson); Sta. Elena, 1 (Miller and Boyle).

153. **Vampyrops dorsalis** *Thomas.*

One specimen (skin without skull), Ricuarte (Richardson).

154. **Artibeus cinereus bogotensis** *Andersen.*

One specimen, Tómeque, near Bogotá (Apolinar Maria).

155. **Artibeus toltecus ravus** *Miller.*

Two specimens, Barbacoas, Aug. 25; Buenavista, Nariño Dept., Sept. 30 (Richardson).

156. **Artibeus jamaicensis æquatorialis** *K. Andersen.*

One specimen (practically a topotype), Cali (3500 ft.), Feb. 8 (Miller).

157. **Artibeus lituratus** (*Illiger*).

Three specimens, Andalucia (3000 ft.), June 17 (Miller).

158. **Artibeus watsoni** *Thomas.*

Four specimens, Dabeiba, Rio Sucio (Miller and Boyle).

DESMODONTIDÆ.

159. **Desmodus rotundus** (*Geoffroy*).

Four specimens, Rio Frio (Miller).

FURIPTERIDÆ.

160. **Furipterus torrens** (*F. Cuvier*).

One specimen, Andagada (Kerr).

VESPERTILIONIDÆ.

161. **Eptesicus andinus** *Allen.*

Five specimens: Valle de las Papas (10,000 ft.), Central Andes, 2; Almaguer (10,300 ft.), 1; El Roble (7000 ft.), 1 (Miller); Fusugasugá (6000 ft.), 1 (O'Connell). (Bull. XXXIII, p. 382, 1914.)

162. **Myotis punensis** *Allen.*

Two specimens, Barbacoas (Richardson). (Bull. XXXIII, p. 383, 1914.)

163. **Myotis esmeraldæ** *Allen.*

Three specimens, Buenavista, Dept. Nariño (Richardson). (Bull. XXXIII, p. 385, 1914.)

164. **Myotis caucensis** *Allen.*

Six specimens: Rio Frio, 1 (Miller); Juntas de Tamana, Chocó district, 5 (Miller). (Bull. XXXIII, p. 386, 1914.)

165. **Eumops milleri** (*Allen*).

Eight specimens, Barbacoas (Richardson).

166. **Molossus bondæ** *Allen.*

Six specimens: Barbacoas, 4 (Richardson); Nóvita, Rio San Juan, 2 (Miller).

CALLITRICHIDÆ.

167. **Œdipomidas geoffroyi** (*Pucheran*).

Œdipomidas salaquiensis ELLIOT, Bull. Amer. Mus. Nat. Hist., XXXI, p. 137, July 23, 1912; Primates, III, 1913, p. 255.

Œdipomidas geoffroyi ELLIOT, Bull. Am. Mus. Nat. Hist., XXXIII, p. 644, Nov. 14, 1914.

Three specimens: Rio Salaqui, 1, type of *Œdipomidas salaquiensis* Elliot; Baudo, 2, July 20, 1912 (Mrs. Kerr).

Additional material from Panama and Baudo shows that the type of *salaquiensis* is not separable from specimens from Panama and the Baudo region. The yellow underparts of *salaquiensis* are evidently due to staining and not normal. In two specimens from Baudo the underparts are clear white in one while the other has the lower abdomen stained yellow, as in the type of *salaquiensis,* except that in the latter the whole ventral surface is yellow. In two specimens from Panama one has the lower abdomen strongly stained with yellow while in the other the whole ventral surface is white. The author was further misled in regard to the size of the type skull of *salaquiensis,* the published measurements of which do not exceed those of Panama specimens instead of being much larger. The type of Pucheran's *Hapale geoffroyi* is stated by him to have been received from Panama.

168. **Œdipomidas œdipus** (*Linné*).

Seniocebus meticulosus Elliot, Bull. Amer. Mus. Nat. Hist., XXXI, p. 31, March 4, 1912; Primates, I, p. 188, col. pl. (frontispiece), pl. xxii, skull.

Œdipomidas œdipus Elliot, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 644, Nov. 1914.

Two specimens, Rio San Jorge, Bolivar (Kerr), an adult male (type of *Seniocebus meticulosus* Elliot) and an adult female.

169. **Œdipomidas leucopus** (*Günther*).

Hapale leucopus Günther, Proc. Zool. Soc. London, 1876, p. 743, pl. lxxii.

Seniocebus pegasis Elliot, Bull. Amer. Mus. Nat. Hist., XXXII, p. 252, July 14, 1913.

Œdipomidas leucopus Elliot, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 645, Nov. 1914.

Four specimens: No. 34563, adult female, type of *Seniocebus pegasis* Elliot, Puerto Berrio, Rio Magdalena, Jan. 29, 1913 (L. A. Fuertes); Puerto Valdivia, 1; Malena, 2 (Miller and Boyle).

One of the Malena specimens has the apical fourth of the tail white.

170. **Callicebus ornatus** (*Gray*).

Twelve specimens: Villavicencio, 5 (O'Connell); Barrigon, 10 miles east of Villavicencio, 7 (Gonzales).

ALOUATTA SENICULUS GROUP.

Simia seniculus Linné, Syst. Nat., ed. 12, 1766, p. 37.

Alouatta, or *Mycetes*, *seniculus*, in part, of most authors.

The only point of value in Linné's brief description of his *Simia seniculus* is the type locality, given as follows: "Habitat Carthagenæ in sylvis ad fluvium." In the absence, in the present connection, of specimens from the immediate vicinity of Cartagena it is impossible to determine whether specimens from the upper Cauca Valley, or from other parts of Colombia, as the Bogotá and Santa Marta districts, represent the typical phase of *seniculus*, but the available material clearly shows, notwithstanding the wide range of individual variation in coloration, size, and cranial details, that there are a number of local, and probably intergrading, phases of the group to which *seniculus* was the first specific name given. In order to define these forms and their distribution and relationships a vast number of specimens will be necessary.

In determining the material recently received at the American Museum

I have attempted to utilize some of the earlier names. This material, numbering about 100 specimens, when laid out in series according to the localities represented, shows that the red howlers of northern South America (*i. e.*, north of Amazonas) fall into seven groups, as follows: (1) Upper Rio Cauca; (2) Santa Marta; (3) northern coast of Venezuela; (4) Bogotá region; (5) Guiana and Lower Orinoco; (6) Trinidad; (7) Rio Caquetá.

Very few of the specific names given by authors to alleged forms of the *seniculus* group rest on a tangible foundation, not even that of locality. The characters given, based at most on two or three specimens, are of such a general character that they fail to be distinctive, and the locality of the type specimens is rarely given more definitely than "Colombia," "Venezuela," or "Brazil." Most authors have erroneously regarded Guiana as the type locality of *seniculus*, and have usually ascribed *ursinus* to Brazil, so that the comparisons they have instituted with these species have been with forms only remotely related to the real *seniculus* or the real *ursinus*.

My material shows that the color of the tail, the basis of I. Geoffroy's *Mycetes chrysuros*, is exceedingly variable. While it is usually of the same general color as the limbs and head, but of a lighter tone, it varies in specimens from the same locality from pale chestnut to dull red, with a tendency to a lighter color apically than at the base; the apical third, or half, or two thirds (as the case may be) may be distinctly yellow, as light in tone as the color of the back. Also, in specimens from the same locality, the range in the intensity of the color of the pelage as a whole varies widely, although the majority of the specimens are practically similar; while the hairs individually, particularly on the head, nape and shoulders, are for the most part of a uniform tint from base to tip, they may be darker at the extreme base in some specimens, while others have the hairs of the head, nape, and shoulders, and sometimes on other parts of the body, broadly annulated with black, or black for even the greater part of their length, but whether due in part to season or age is not easily determinable.

The skull varies greatly not only with sex and age, but through purely individual variation; the skull of the female is usually considerably smaller than that of the male and much less heavily ossified. Practically adult skulls vary greatly in massiveness with age, and consequently in size, growth through the deposition of bony matter apparently continuing as long as the animal lives. Distinctions based on the skull are therefore difficult to establish without a large amount of strictly comparable material from different localities. In the case of the Santa Marta form (*Alouatta seniculus rubiginosa*), described by me in 1904, the skull proves to be considerably above the average size for the *seniculus* group, relatively very broad, with, correlatively, very broad nasals. The two forms, *rubiginosa* and *caucensis*, stand well apart from each other, both in coloration and in cranial characters, and also from the other forms here recorded.

In recently describing *Alouatta seniculus bogotensis*[1] I had occasion to consider some of the earlier names given to Colombian forms of this group, as follows:

"In this connection it is necessary to consider two earlier names for red howlers from 'Colombia.' The first is *Stentor chrysuros* I. Geoffroy (Mém. du Mus. d'Hist. nat. Paris, XVII, 1828 [1829], pp. 166, 171; Guérin's Mag. de Zool., 1832, Cl. I, pl. 7, text and colored plate), described from three specimens collected by M. Plée and believed to have come from 'la vallée de la Madeleine.' On geographical grounds they would seem referable to *Alouatta seniculus* (Linn.), the type locality of which is Cartagena, Colombia. Comparison is made by Geoffroy with '*Stentor seniculus*,' but his specimens of *seniculus*, as he states, were from Guiana, as his comparison also shows, and hence with what is now known as *Alouatta seniculus macconnelli*. His principal character of *chrysuros* was the color of the tail, the apical half of which was 'd'un fauve doré très brillant,' like the color of the back, present in two of his three specimens and less pronounced in the third. As is well known, the color of the tail in the red howlers varies from red to yellow in specimens from the same localities, so that the alleged character obviously has no value. It seems best therefore to consider *chrysuros* as a synonym of typical *seniculus*, where it has usually been placed.

"The second name is *Mycetes laniger* J. E. Gray (Ann. and Mag. Nat. Hist., XVI, p. 219, Oct. 1845), from 'Colombia,' and 'purchased at Paris.' As the description is inadequate for the identification of the species, and there is no definite type locality, the species is indeterminable without examination of the type, presumably extant in the British Museum."

171. **Alouatta seniculus caucensis** *Allen*.

Alouatta seniculus caucensis Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 462, figs. 2, 4, Nov. 28, 1904. (Upper Rio Cauca, Colombia).

Twenty-one specimens, all from western Colombia: Rio Salaqui, 1 (Kerr); Salento, 4; Rio Frio, 7 (Miller); Frijolera, Antioquia, 5 (Miller and Boyle); Las Lomitas, 1; Güengüe, 1 (Richardson); San Agustin, 2 (Miller).

These agree well in the main with the type series (8 specimens) from Charingo, Upper Cauca region, but present phases of pelage not well represented in the original series. The specimens from the southern part of the Western Andes and those from San Agustin, in the southern part of the

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[1] Bull. Amer. Mus. Nat. Hist., XXXIII, 1914, p. 649.

Eastern Andes, are indistinguishable, but those from Salento and Rio Frio, in the northern Central Andes, differ in having the nape and shoulders darker and more varied with black, the hair of these parts being red at the surface with a broad band of black below, sometimes extending to the base of the hair; in other instances the black basal portion is divided by a broad annulation of red. As most of these specimens are young adults it may be that this is a phase of coloration due to age, especially as some of the older specimens are quite like comparable specimens in the type series.

The single specimen, an adult female, from the Rio Salaqui, northwestern Colombia, is quite like comparable specimens from the Upper Cauca region.

172. **Alouatta seniculus rubicunda** *Allen.*

Alouatta seniculus rubicunda ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 458, figs. 1, 3, Nov. 28, 1904. (Bonda, Santa Marta, Colombia).

There is nothing to add by way of qualification or correction of the detailed description already given (*l. c.*), except to say that the type locality of *A. senicula,* given as "Guiana," should be corrected to Cartagena, Colombia. The large amount of material since received from other localities confirms the distinctions based on the Santa Marta series, except in regard to the alleged curvature of the maxillary toothrows, which proves to be not constant, in most specimens the toothrows being straight, as in other forms of the *seniculus* group.

173. **Alouatta seniculus bogotensis** *Allen.*

Five specimens, Subia, near Bogotá (Gonzales). (Bull. XXXIII, p. 648.)

174. **Alouatta seniculus caquetensis** *Allen.*

Two specimens, La Murelia = Muralla (Miller). (Bull. XXXIII, p. 650.)

175. **Alouatta æquatorialis** *Festa.*

One specimen, adult male, Ricuarte (Richardson).

Total length, 1270 mm.; head and body, 690; tail vertebræ, 580; hind foot, 140. Skull, total length, 118; occipitonasal length, 99; zygomatic breadth, 84; orbital breadth, 61; interorbital breadth, 12; postorbital breadth, 41; breadth of braincase, 52; breadth of rostrum at canines, 32; palatal length, 42; palatal breadth at m^1, 23; nasals, 19 × 12; maxillary toothrow, 34.

[The following forms are added as pertinent to the present consideration of the *Allouatta seniculus* group, although not occurring within the prescribed limits of this paper.

Alouatta seniculus ursina (*Humboldt*).

Simia ursina Humboldt, Observ. de Zool. et Anat. comp., I, livrs. 1 (1st. issue, 1805, apud Sherborn[1]), pp. 8, 331, 355, pl. xxx (2d issue, 1812), part; not the plate, and not the Rio Orinoco references.

Stentor ursinus E. Geoffroy, Ann. de Mus. d'Hist. nat. Paris, XIX, 1912, p. 108 (ex Humboldt).

Mycetes ursinus Desmarest, Mamm. I, 1820, p. 78 (ex Humboldt).— Kuhl, Beitr. zur Zool., 1820, p. 29, part.— Also, in part, of subsequent authors.

Mycetes seniculus Wagner, Schreber's Säuget., Suppl., I, 1840, p. 179, part, only the reference to Humboldt; *ibid.*, V, 1855, p. 67, part.

The type locality may be fixed as Caracas, Venezuela, on the basis of the vernacular name, *Abraguato de Caracas,* employed for it by Humboldt in his description, although the range he assigned to it embraced a large part of Venezuela, including the Lower Orinoco. The brief diagnosis is inadequate for the determination of the species, and the plate should be excluded from consideration, it having been based on a monkey 'probably from Brazil' ("Cet individu est probablement originaire du Brésil").

Five specimens, Venezuela: Cristobal Colon, 3 (Miller); El Hacha, 2 (Carriker).

These specimens, in their very dark coloration, resemble *A. s. rubicunda,* but the Cristobal Colon specimens are even darker than that form, the limbs being blackish chestnut, the head and tail very dark, and the back chestnut red. The external measurements and the skulls indicate a much smaller form than *rubicunda,* with a narrower skull and much narrower nasals.

The specimens vary greatly individually in intensity of coloration. The darkest one from Cristobal Colon has the fore limbs and beard nearly black, and the tips of the hairs on the back are dark red; in another the fore limbs and beard are dark purplish chestnut, the tips of the hairs on the back orange red; the other is intermediate between these two. Of the two specimens from El Hacha one, taken Jan. 6, is as dark as the Cristobal Colon specimens, the other (taken Nov. 27) is the lightest of the series of five and has the pelage more worn.

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[1] Ann. and Mag. Nat. Hist. (7), III, p. 428, May, 1899.

Alouatta seniculus macconnelli *Elliot.*

Alouatta macconnelli Elliot, Ann. and Mag. Nat. Hist. (8), V, p. 80, Jan. 1910; Primates, I, p. 281, 1913, part.— Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 148, May 27, 1910; *ibid.*, XXX, p. 271, Dec. 2, 1911 (Rio Mato and El Llagual, Venezuela).

Three adult specimens, 1 male, 2 females, Tumatumari, British Guiana, August 1, 1913 (Miller).

Collector's measurements, total length, ♂ 1190, ♀ ♀ 1130, 1080; head and body, 600, 510, 500; tail vertebræ, 590, 510, 500; hind foot, 140, 135, 125.

Skull, total length, ♂ old, 131, ♀ young adult, teeth not worn, 118; occipitonasal length, 107, 91; basal length, 121, 91; zygomatic breadth, 80, 70; orbital breadth, 64, 60; postorbital breadth, 39, 44; palatal length, 54, 40; palatal breadth at m^1, 23, 20; nasals, 25 × 15, 22 × 10; maxillary toothrow, 34, 32.

The Guiana specimens agree in coloration with the description of the type. Lower Orinoco specimens closely resemble those from Guiana, having the fiery golden tinge so characteristic of Guiana specimens.

Alouatta insulanus *Elliot.*

Alouatta insulanus Elliot, Ann. and Mag. Nat. Hist. (8), V. p. 79, Jan. 1910; Primates, I, 1913, p. 382.

One specimen, a flat skin without skull, Island of Trinidad, B. W. I., April, 1894 (F. M. Chapman).

In the nearly uniform coloration this insular form is very different from the red howlers of the Venezuela mainland.]

176. **Pithecia milleri** *Allen.*

Two specimens, La Murelia (Miller). (Bull. XXXIII, p. 650, 1913.)

[The following species is added here as being a convenient place of record for the measurements.

Pithecia pithecia (*Linné*).

Four adults, British Guiana: Potara Landing and Kaieteur Falls, 2 males; Tumatumari, 2 females (Miller).

The male was not measured. Two females, total length, 830, 760 mm.; head and body, 400, 340; tail vertebræ, 430, 420; hind foot, 130, 110.

Skull, total length, ♂ 75, ♀ ♀ 76.5, 74; occipitonasal length, 71, 72, 69.5; zygomatic breadth, 52, 51, 51; orbital breadth, 39.5, 40.3, 40.8; postorbital breadth, 33, 33, 34; interorbital breadth, 5, 5.5, 5.6; breadth of braincase, 39, 40, 41; breadth of rostrum at canines, 21.8, 22, 21.5; palatal length, 25, 26.5, 25; breadth of palate at m^1, 12, 12, 12; nasals, 17 × 8, 16 × 7, 17 × 7; maxillary toothrow, 17.6, 18.6, 18.

Judging by the skull and teeth, these three specimens are all quite old and very nearly of equal age. Apparently there is very little sexual difference in the size of the skull.]

177. **Saimiri caquetensis** *Allen.*

Five specimens, all adult males: Florencia, 2 (Miller); Barrigona (southwest of Bogotá), 3 (Gonzales). (Bull. XXXV, p. 87, April 28, 1916.)

178. **Aotus lemurinus** (*I. Geoffroy*).

Nyctipithecus lemurinus I. Geoffroy, Arch. du Mus. d'Hist. nat. de Paris, IV, 1844, p. 24, pl. ii. Santa Fé de Bogotá, Colombia.

Aotus vociferans Elliot (not of Spix), Primates, II, 1913, p. 13 (part).

Aotus aversus Elliot, Bull. Amer. Mus. Nat. Hist., XXXII, p. 251, July 14, 1913. Fusugasugá, about 30 miles southwest of Bogotá (alt. 6000 ft.), Colombia.

Four specimens: Fusugasugá (alt. 6000 ft.), 2, type and topotype of *Aotus aversus* Elliot (*l. c.*); Subia (about 30 miles west of Bogotá, same altitude and faunal zone as Fusugasugá), 2 (Gonzales).

The Fusugasugá specimens were taken March 30, and are in faded and worn pelage; the Subia specimens were taken July 15, or more than three months later in the season, and are in fresh, unworn pelage. The black lateral head stripes extend to the occiput, and blackish prevails over the mid-dorsal region, due to the long blackish tips to the hairs, which have disappeared by wearing in the type and topotype of *aversus,* so that the black head stripes do not reach the occiput. The head, sides of the body, and outside of the limbs are also of a much clearer gray in the July specimens, through the wearing off of the glistening gray tips in the March specimens.

The type series of I. Geoffroy's *Nyctipithecus lemurinus* (five specimens, *l. c.;* also I. Geoffroy's Cat. méth. Coll. des Mamm. de Mus. d'Hist. nat., 1851, p. 39) came from near Bogotá; he also refers to the considerable amount of individual variation in color presented by his specimens. As Bogotá is on an unforested plateau, Geoffroy's types must have come from some nearby forested region, and doubtless the specimens here recorded may be considered as practically topotypes.

179. **Aotus zonalis** *Goldman.*

Aotus griseimembra Allen (not of Elliot), Bull. Amer. Mus. Nat. Hist., XXXI, p. 95, April, 19, 1912.

Aotus zonalis Goldman, Smiths. Misc. Coll., LXIII, No. 5, p. 6, March 14, 1914.

Three specimens, Rio Sinu, Bolivar Province (Kerr).

180. **Aotus lanius** *Dollman.*

Aotus lemurinus Allen (not of I. Geoffroy), Bull. Amer. Mus. Nat. Hist., XX, 1904, p. 465 (part, not the Santa Marta specimens).

Aotus lanius Dollman, Ann. and Mag Nat. Hist. (8), IV, Sept. 1909, p. 202, Tolima Mts. (alt. 6000 ft.), Colombia.

Aotus pervigilis Elliot, Bull. Amer. Mus. Nat. Hist., XXXII, p. 252, July 14, 1913. La Candela (alt. 6500 ft.).

Twenty-six specimens: Rio Toché, 1 (Chapman); Salento, 8; West Quindio Pass (9000 ft.), 3 (Miller); near Cali (6000 ft.), 7 (Batty); La Candela (6500 ft.), 3 (Miller), type and paratypes of *A. pervigilis* Elliot; Frijolera, 3 (Miller and Boyle); Alto Bonito, 3 (Miller and Boyle).

I am unable to find satisfactory characters for the separation of these several series of specimens, when seasonal differences of pelage and coloration are taken into account. The type and paratypes of *A. pervigilis* are in worn pelage, and the black tips of the hairs on the tail are worn off, so that the apical part of the tail appears less black. The series from the Salento district are, as a series, much grayer and less rufous than those from the Cali district, but they are all young animals, with the permanent dentition not fully developed. Two or three of the series are adult, and they so closely resemble specimens from the Cali district that they are readily separable only by the labels.

181. **Aotus griseimembra** *Elliot.*

Aotus lemurinus Allen (part, not of I. Geoffroy), Bull. Amer. Mus. Nat. Hist., XX, p. 465, Nov. 28, 1904 (the Santa Marta specimens only).

Aotus griseimembra Elliot, Bull. Amer. Mus. Nat. Hist., XXXI, p. 33, March 4, 1912.

Four specimens: Hacienda Cincinnati, Santa Marta, Colombia, 2, type and paratype (M. A. Carriker, Jr.); Bonda, 1 (now mounted), and Valparaiso, Santa Marta, 1 (H. H. Smith Coll.).

182. **Ateles robustus** *Allen.*

Five specimens: Gallera, 4, type and topotypes (Miller; Bull. XXXIII, p. 652, 1913); Barbacoas, 1 (Richardson).

183. **Lagothrix lagotricha** (*Humboldt*).

One specimen, Muralla, Caquetá district (Miller).

This specimen differs from the La Palma series (*L. lugens*), from an altitude of 6000 feet, in the pelage being very much shorter and less woolly and the hair on the outer edge of limbs and upper surface of tail not especially lengthened. The general color above is dull brownish gray, lighter on the lower back, and much lighter on the outside of the limbs; crown-patch well defined and pale brown; chin and throat pale brown; chest pale chestnut brown; lower abdomen and anal region black, many of the hairs with gray tips. No measurements were taken and the skull was lost.

The general coloration is much lighter and grayer than even the lightest colored specimens of the *lugens* series, while the character of the pelage is widely different.

184. **Lagothrix lugens** *Elliot.*

Lagothrix lugens Elliot, Ann. and Mag. Nat. Hist. (7), XX, p. 193, Sept. 1907; Primates, II, 1913, p. 58.

Five adult specimens, 3 males, 2 females, La Palma, alt. 6000 ft. (Miller).

The collector's measurements of a male and female (the others not measured), total length, ♂ 1000, ♀ 1090 mm.; head and body, ♂ 480, ♀ 490; tail vertebræ, ♂ 620, ♀ 600; hind foot, ♂ 150, ♀ 120.

An adult male skull measures, total length, 106 mm.; occipitonasal length, 92; zygomatic breadth, 71.8; orbital breadth, 62; interorbital breadth, 10; postorbital breadth, 46; breadth of braincase, 58; breadth of rostrum at canines, 31; nasals, 11 × 13; palatal length, 33; maxillary toothrow, 22.5.

The series of five adults presents a wide range of individual variation in coloration. Two of them, one a male, the other a female, are nearly uniform dull brownish black throughout, the hairs tipped very slightly with lighter over most parts of the upper surface, but most strongly so on the lower back, the sides of the body, and outside of the limbs.

Two other specimens, also male and female, have a rather distinctly defined blackish brown crown, a paler brown area over the shoulders, and the lower back, outer surface of hind limbs, and upper side of the tail gray. The fifth specimen is intermediate between the two extreme phases. The underparts in all are much alike, and distinctly darker or more blackish than the upperparts; in only one is the chest and throat strongly suffused with brownish, but in two others these parts have a brownish cast, in contrast with the rest of the ventral surface. The pelage in all is long and woolly, and very long on the outer edge of the limbs and the under side of the tail, the hair on the tail in some of the specimens having a length of 70 to 90 mm. Some of the males have very long hair on the chest, in some specimens 180 to 220 mm. long.

185. **Cebus capucinus nigripectus** *Elliot.*

Five specimens: Baudo, 1 (Kerr); Rio Frio, 3 (Miller); San Antonio, 1 (Richardson).

Nearly all are immature; a male and a female have the permanent dentition fully developed, but the skulls would have increased somewhat in size with age.

These specimens, like the type series of *nigripectus,* are none of them fully grown, which of course would affect the measurements to some extent, both external and cranial. Compared, however, with specimens of corresponding age from Chiriqui, Costa Rica, and Nicaragua, they are obviously much smaller, with correspondingly weaker dentition. Externally they differ from Central American specimens in the extension of the black on the underparts forward over the chest, but the color difference on the forehead alleged in the original description of *nigripectus* does not hold. The markedly smaller size, weaker dentition, and extension of black over the chest serve to distinguish *nigripectus* from the Central American form, which Goldman has recently proposed (Proc. Biol. Soc. Washington, XXVII, p. 99, May 11, 1914) to designate as *Cebus capucinus imitator,* he restricting true *capucinus* to northern Colombia (type locality, by designation, the Rio Sinú, northwestern Colombia).

In the absence of specimens of *capucinus* from the type region it seems proper to retain provisionally the name *nigripectus* for the form represented by specimens from the upper Rio Cauca.

With some 40 skulls of the *capucinus* group before me for study, I fail to appreciate the alleged difference of relatively wider premolars in the Central American form. Different specimens from the same locality differ greatly in this respect, the molars being also especially variable in size and form in the series as a whole. There is often a tendency to a marked reduction in size of m^3, which is a very unstable tooth. The greatest reduction is in No. 18942, an adult female from Boqueron, Chiriqui, in which m^3 is reduced, on each side, to a slender column not larger than p^3 in some species of squirrels, it being less than one fifth of the normal size.

186. **Cebus fatuellus** (*Linné*).

Eight specimens: Villavicencio, 1 (O'Connell); Barrigona, 2 (Gonzales); La Palma, 2; La Candela, 1; Muralla 1 (Miller).

Collector's measurements of 1 young adult male from Villavicencio and

1 adult and 1 young adult female from Barrigona: Total length, ♂ 760, ♀ 830, ♀ 750 mm.; head and body, 360, 360, 360; tail vertebræ, 400, 470, 390; hind foot, 113, 110, 108. Skulls of same, total length, ♂ juv. 87, ♀ ad. 89, ♀ juv. 86; basal length, 59, 58, 57; zygomatic breadth, 56, 57, 52; orbital breadth, 45, 47, 44; interorbital breadth, 5, 4, 4; postorbital breadth, 37.3, 39, 38; breadth of braincase, 51, 51, 48.5; breadth at canines, 24, 24, 25; palatal length, 29, 31, 28; palatal breadth at m^1, 16.5, 17, 16; nasals,[1] 18 × 8.5, 22 × 8, 18 × 8; maxillary toothrow, 22, 21, 21.

No external measurements are available for the specimens from La Palma and La Candela. Two adult skulls from La Palma measure: Total length, ♂ 103, ♀ 93; basal length, 73, 75; zygomatic breadth, 75, 61.3; orbital breadth, 56, 48.6; interorbital breadth, 5.3, 4.3; postorbital breadth, 41, 41; breadth of braincase, 51, 51; breadth at base of canines, 30.6, 29; palatal length, 36, 32.5; palatal breadth at m^1, 19, 17; nasals, 20 × 7, 14 × 8.5; maxillary toothrow, 24, 22.

The two series agree in coloration, and the difference in size is probably due to the immaturity of two of the Barrigona specimens.

Cebus fatuellus is taken on the basis of Elliot's 'Review of the Primates,' II, p. 102.

[The following two forms are added for comment.

Cebus apella apella (*Linné*).

Two specimens, adult male and female, Tumatumari, British Guiana, July, 1913 (Miller).

Collector's measurements of the female (male without measurements): Total length, 830 mm.; head and body, 440; tail vertebræ, 390; hind foot, 135. Skulls, total length, ♂ 98, ♀ 93; basal length, 69, 61; zygomatic breadth, 65.5, 58; orbital breadth, 56, 50; interorbital breadth, 5.2, 5.3; postorbital breadth, 40, 40; breadth of braincase, 53.5, 53; breadth of rostrum at canines, 27.5, 23.6; palatal length, 34, 32; breadth of palate at m^1, 18, 17; nasals, 19 × 11, 17 × 10; maxillary toothrow, 21.

Cebus apella apiculatus *Elliot.*

Cebus apiculatus Elliot of the Lower Orinoco is closely related to *apella*. In a series of 12 specimens in the American Museum from the type region of *apiculatus* (several of them are topotypes), two closely resemble true *apella*, but as a series the *apiculatus* form is much more reddish brown, with the upper arms lighter or paler than in Guiana specimens; it is easily distinguished and should stand as *Cebus apella apiculatus*.]

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[1] The nasals extend in a narrow point far above the fronto-maxillary suture.

56.9,8: 14. 31.4

Article XIX.— STUDIES ON THE EVOLUTION OF THE PRIMATES.

By William K. Gregory.

Part I. The Cope-Osborn "Theory of Trituberculy" and the Ancestral Molar Patterns of the Primates.

(Figs. 1–18 and Plate I.)

1. *Critique of the Cope-Osborn "Theory of Trituberculy."*

In 1895 Professor Osborn[1] applied to the cusps of the human molars the system of nomenclature which he had invented at an earlier period for the molar patterns of Eocene mammals, replacing such cumbrous terms as anterior palatal, anterior buccal, etc., with the simple and easily remembered terms protocone, paracone, metacone, hypocone, for the cusps of the upper molars, and protoconid, metaconid, hypoconid, entoconid and hypoconulid for those of the lower molars. "When we understand," he continued, "that all the teeth of all mammals have this key, this tritubercular key, we can unlock the comparisons through the series and point out the homologies," a statement which after certain reservations and restrictions have been made, is still, in the judgment of the writer, essentially true.

For some years past the "theory of trituberculy" upon which Osborn's nomenclature originally rested has fallen into disfavor. Unfortunately the original theory of trituberculy included four distinct propositions of very unequal value: the first proposition is that normal ungulates, carnivores and primates once passed through a stage in which the upper molars were tritubercular, or more properly trigonal, while the lower molars were tuberculosectorial, that is with a cutting trigonid and a crushing talonid. (Fig. 1, C, D).

This proposition rests upon the broadest basis of fact. During the past twenty odd years American Museum expeditions have collected many thousand specimens of fossil mammals, from a long and closely graded series of horizons in the Paleocene, Eocene and later formations of the West. These enormous collections, which are now being studied and described by Professor Osborn, Dr. Matthew, Mr. Granger, and the present writer, afford overwhelming proof of the statements made above, namely that trigonal upper molars and tuberculo-sectorial lower molars are truly ancestral in pattern and may be traced along divergent lines into the more complex molars of various groups of insectivores, carnivores, condylarths, perissodactyls, primates and other orders. On another occasion I hope to be able to supply visual evidence for these statements.

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[1] The History of the Cusps of the Human Molar Teeth. International Dental Journal, July 1895. Reprinted in "Evolution of Mammalian Molar Teeth to and from the Triangular Type," 1907, p. 63.

The second and later developed proposition of the "theory of trituberculy" was that triangular molars had been derived from the tricondont type with three cusps in fore-and-aft line, by the migration, or circumduction, of the two marginal cusps, outward in the upper jaw and inward in the lower jaw. A prodigious quantity of German and English text has been produced in demolishing this frail hypothesis, often only for the purpose of setting up still frailer ones, such as the concrescence hypothesis which is supported even at the present day by Dr. Marett Tims (1914, p. 1) and Professor Bolk. But these authors have not realized that in disproving the cusp-circumduction hypothesis (if indeed they have disproved it) they have only rid the theory of trituberculy of a worse than useless encumbrance (Fig. 2). It is true that in the Order Triconodonta the genera *Menacodon* (Fig. 2D) and *Spalacotherium* (Fig. 2E) appear to supply evidence for the view that in their ancestors the para- and metaconids had been circumducted from an antero-posterior line, so as to make a triad of cusps, in the manner assumed in the Cope-Osborn hypothesis; but while, as I have elsewhere argued (1910, pp. 173–177), the assumed circumduction of cusps may very well have

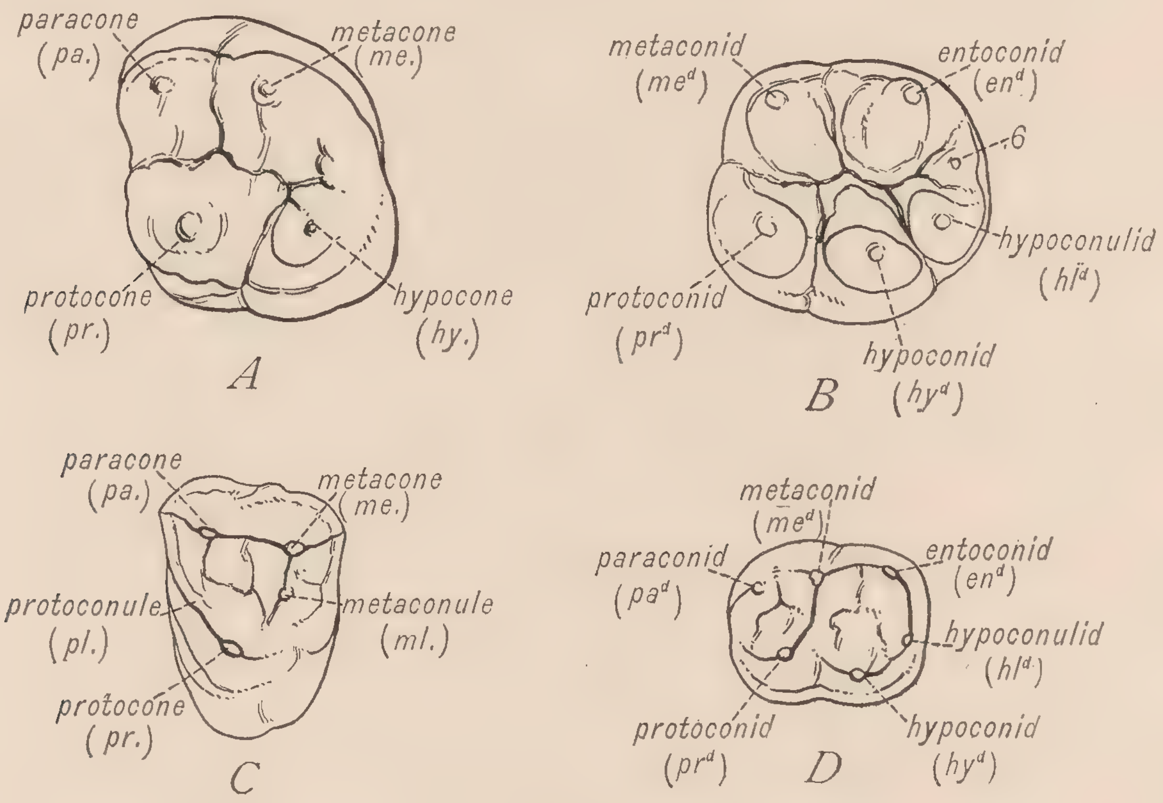

Fig. 1. The Osbornian nomenclature of the molar cusps.
A. Second left upper molar of man (Kaffir).
B. Second left lower molar of man (Australian black).
C. Second left upper molar of *Pelycodus trigonodus*, a Lower Eocene lemuroid.
D. Second left lower molar of the same.
C and D represent the primitive, tritubercular upper molar and tuberculosectorial lower molar.

occurred in the Metatherian order Triconodonta, there is little basis for assuming the same mode of origin for the quite differently appearing trigonids of the contemporary Trituberculata and later Placental Mammals.

A third correlated part of the original theory was that in ancestral stages the crowns of the upper and lower molars formed "reversed triangles," the lower triangle, or trigonid, with its apex external, the upper triangle, or trigon, with its apex internal. This proposition was not simply a generalization of observed facts; it involved also the inference that the inner cusps of the upper molars were in a sense homologous with the outer cusps of the lower molars and *vice versa.*

A fourth proposition of the original theory of trituberculy is that the summit of the haplodont reptilian molar crown lies on the inner side of the upper, and on the outer side of the lower molars. This idea is closely connected with the proposition that in primitive types the upper and lower teeth form "reversed triangles." But while the latter is essentially true the former is open to considerable doubt, and has been especially attacked by those who uphold the "premolar analogy" theory. After many years of unbiased study of this problem I may briefly summarize my views on this highly debatable matter.[1]

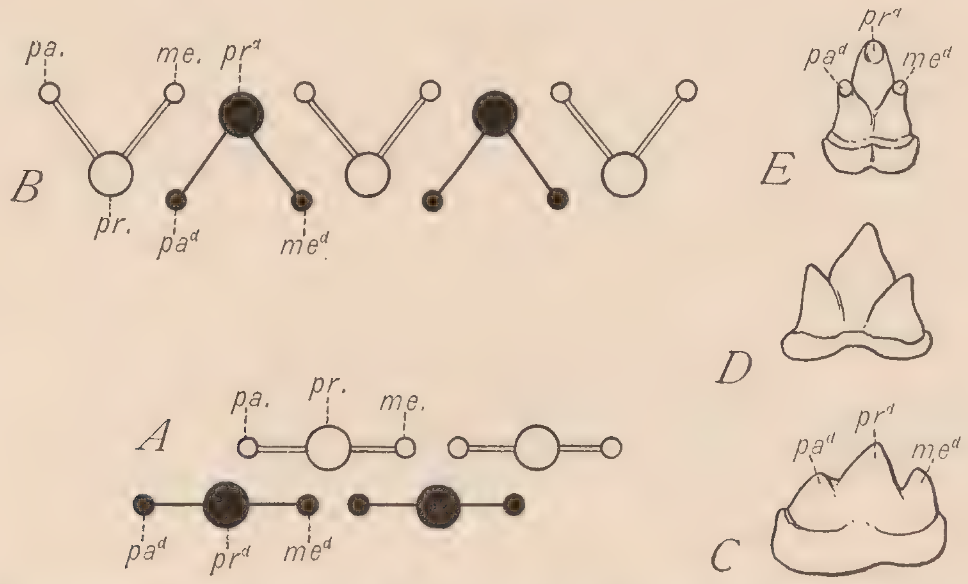

Fig. 2. The Cope-Osborn hypothesis of the circumduction of the para- and metacones.

A. Triconodont stage with all three cusps in the same anteroposterior plane, as represented by *Amphilestes* (C).

B. Tritubercular stage with the two minor cusps circumducted to the outer side in the upper teeth (white) and to the inner side in the lower (black).

C. A lower molar of *Amphilestes*, Jurassic, England.

D. A lower molar of *Menacodon*, Jura-Cretaceous, Wyoming. Inner side showing the paraconid and metaconid partly displaced to the inner side of the crown.

E. A lower molar of *Spalacotherium*, Jurassic, England. Paraconid and metaconid completely displaced to the inner side of the crown.

This hypothesis is applicable, if at all, only to the origin of the molar patterns of the Triconodonta and not to other orders of mammals.

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[1] See also the discussions of this subject by the present writer in "The Orders of Mammals" (1910, pp. 181–195) and, in collaboration with Professor Osborn, in the "Evolution of Mammalian Molar Teeth" (1907, pp. vi, 215–225).

First the "premolar analogy theory" assumes that the molars in pre-Tertiary times passed through precisely the same stages of progressive complication that are observed in the premolars of Tertiary phyla. This leaves entirely out of account the possibility that the final resemblances between premolars and molars may have resulted from the convergent evolution of non-homologous cusps. Nevertheless the resemblance between the fourth premolars and first molars, even in Paleocene times, was so pronounced, in so many families and orders, as to make it appear probable that in a general way the outer part of the fourth premolar is homologous with the outer part of the molars, and the inner part of the fourth premolar with the inner part of the molars. Hence I do not think there is sufficient evidence for the Scott-Osborn view that the main external cusp of p^4 is serially homologous with the main internal cusp of m^1. On the contrary the fourth upper premolar appears to be truly more primitive in form than the first upper molar, especially in that its crown forms only a single pair, consisting of one external and one internal cusp, while the first molar very often becomes divided into two moieties, the anterior moiety, consisting of the paracone and protocone and the posterior moiety consisting of derived cusps the metacone and hypocone, as more fully explained below (p. 253). Similarly the fourth lower premolar in all primitive Eutherian types appears to be more primitive in form than the first lower molar and it seems to show that the talonid has developed to fill up the interspace between the successive lower molars and to oppose the large internal cusp of the upper molars. As we follow the lower premolars forward we note that the talonid becomes shorter and narrower, until we reach the anterior premolars which have not yet acquired it. This sequence may be observed not only in many modern insectivores and lemuroids but also in many families of Eocene mammals.

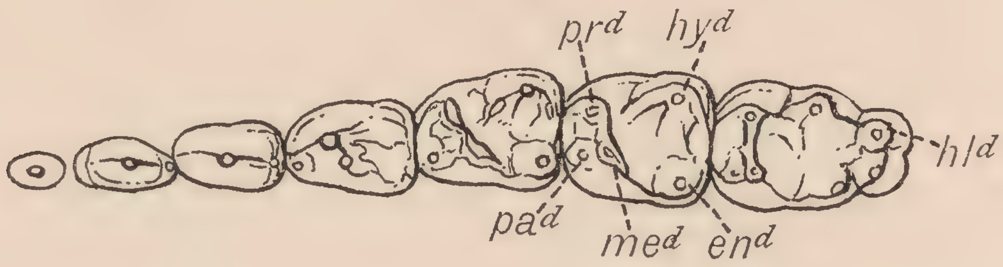

Fig. 3. Lower premolar and molar patterns of *Notharctus*, a Lower Eocene lemuroid. Crown view, twice the natural size.

Illustrates the complication of the molar pattern, through the great development of the talonid. The pattern of the fourth lower premolar is intermediate between that of the simple third premolar and that of the first molar. The wide basin of the talonid of the lower molars is correlated with the large size of the protocone of the upper molars, while the external position of the hypoconid implies the fact that in the upper molars the tips of the para- and metacones lie near the outer side of the crown.

The adaptive meaning of the simplification of the premolars as we pass forward is as follows: the anterior teeth are further away from the fulcrum, which is the glenoid articulation, and further away from the insertion areas of the masseter, temporal and pterygoid muscles. Hence the anterior teeth sweep through a larger arc, that is, have greater velocity than do the molars, which are, on the other hand, in the best position for exerting slow vertical pressure. The premolars are thus intermediate in position and in function between the canines and the molars. But a greater velocity, associated with a smaller cross section and a sharper tip, imparts to the canines a relatively great piercing power. Consequently the anterior teeth retain the original haplodont crown, while in the cheek teeth this crown has become expanded and subdivided. These facts and considerations hold true not only in the mammals but also in *Cynognathus* and other extinct mammal-like reptiles.

In many Early Tertiary and primitive modern mammals as we pass backward from the simple conical first upper premolar through the progressively more complex p^2, p^3, and p^4 to the first molar we observe that the main high cusp of the premolars, which apparently represents the tip of the reptilian tooth, stands in anteroposterior line not with the protocone of the molars, but with the paracone and metacone (Plate I). As this is true not only in the examples cited by Dr. Wortman and others but in all primitive placental and marsupial mammals it constitutes the strongest point of the "premolar analogy theory" and tends to show that the paracone of the molars and not the protocone usually represents the tip of the original reptilian crown. If this is not the case we must suppose that the original summit of the upper molar crowns has been widely displaced inward, while the summit of the lower molar crowns has remained in the same anteroposterior line with that of the premolars (Fig. 3), an hypothesis which appears to be irreconcilable with the observed interlocking relations of the upper and lower cusps and depressions in any primitive mammal (Fig. 8).

That the outer side of the upper molar crowns is older than the inner side, namely that the region of the paracone and metacone is older than the region of the protocone, is clearly suggested also by the form of the deciduous molars (Fig. 4) and by the relations subsisting between the deciduous molars and the true molars in many families and orders of mammals. For several reasons the deciduous molars appear to belong to the same set with the permanent molars and to have been derived from the same strip of the dental lamina. The posterior deciduous molar and the first true molar are usually found in association and the posterior deciduous molar is practically always more molariform than the tooth which replaces it, which in primitive mammals is usually unlike the molars (Fig. 4). The premolars or replacing teeth, on the other hand, appear to belong to the same series

EXPLANATION OF PLATE I.

Homologies of the external, middle and internal rows of cusps in the premolar-molar series of primitive placentals and marsupials.

A–D. Zalambdodont Insectivore series. Internal row (protocones) progressively reduced, middle row (para-, metacones) growing inward, as held by Mivart, M. A. Woodward, Gidley and Matthew. A after Matthew.

E. *Dryolestes* (*Phascolestes*). Order Trituberculata (Pantotheria). Based on Osborn's figures. Interpretation of cusp rows doubtful.

F–G. *Apternodus, Chrysochloris.* Order Insectivora, suborder Chrysochloroidea. Middle row growing inward, inner row reduced.

H. *Didelphodus absarokæ.* Order Carnivora. Fam. Oxyclænidæ (?) A primitive carnivore with all three rows well developed; the protocone row growing out, as usual, from the internal base of the crown.

I. *Proscalops secundus.* Order Insectivora, suborder Soricoidea. A primitive talpid. After Matthew.

J. *Tricentes.* Order Carnivora. Fam. Oxyclænidæ. Outer row reduced in size. Inner cusps small in premolars, large in molars.

K. *Peralestes.* A Mesozoic form of doubtful relationships. Interpretation of cusp rows doubtful. The inner row may represent the red series (paracones). Compare Marsupials. After Osborn.

L. *Marmosa chapmani.* Order Marsupialia. Fam. Didelphiidæ. The first molariform tooth is the deciduous molar. The enlarged metacones of the molars may represent the original tip of the crown (red series). Outer cusps greatly developed.

M. *Didelphis.* Order Marsupialia. Fam. Didelphiidæ.

N. *Haplomylus.* Order Condylarthra. Fam. Hyopsodontidæ. A tritubercular condylarth. Inner row enlarged, outer row small. After Matthew.

O. *Omomys.* Order Primates. Fam. Tarsiidæ. A tritubercular tarsiiform primate with enlarged protocones and reduced outer cusps. After Matthew.

P. Q. R. Order Insectivora. Suborder Erinaceoidea. Fam. Leptictidæ. Primitive relatives of the Erinaceidæ. Inner row enlarged, outer row reduced.

Inspection of this series appears to support the following conclusion:

(1) The three main rows of cusps (green, red, yellow) are respectively homogenous throughout the placental orders named.

(2) The middle row (red) of the molar cusps are serially homologous with the single tips of the premolar crowns and are older than the inner row (yellow), or protocone series, which are ingrowths from the base of the crowns.

(3) The outer row (green) are upgrowths of the external basal cingulum.

(4) All three rows are well developed in primitive placentals, but frequently the outer row becomes reduced and the inner row becomes greatly enlarged.

as the vestigial "post-permanent" buds of the dental lamina. As we follow the deciduous molars forward there is a more or less gradual transition and simplification in form from m^1 through dm$\frac{3}{3}$ and dm$\frac{2}{2}$ to the more simple conical crown of dm$\frac{1}{1}$. In every case observed the inner parts of the anterior upper deciduous molars, namely the region of the protocone, seem to represent an ingrowth from the outer portion of the crown, more or less similar to the internal extension of the crown in the upper premolars. The molariform character of the posterior deciduous molar, the more or less gradual transition in form from dm$\frac{3}{3}$ to dm$\frac{1}{1}$ and the shelf-like appearance of the inner

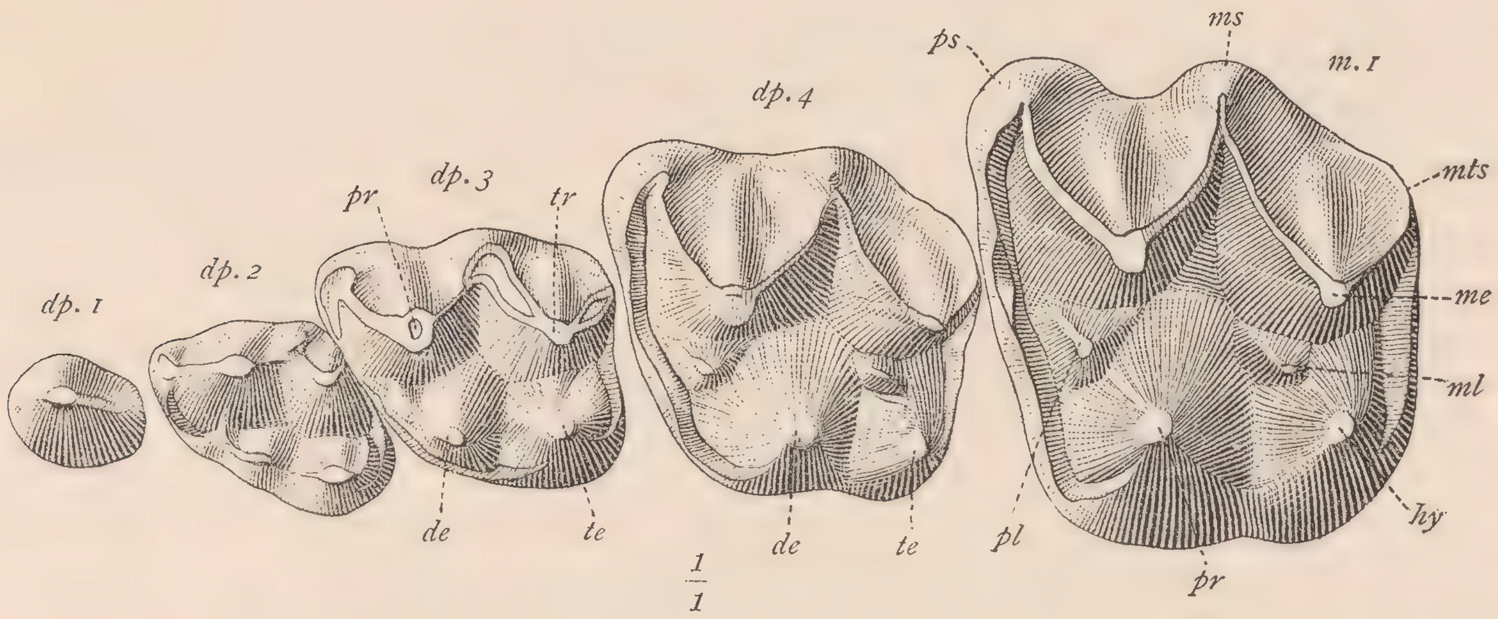

Fig. 4. Deciduous molars and first molar of *Palæosyops leidyi*, a Middle Eocene titanothere. After Osborn.

The first tooth of the series, wrongly marked dp^1, is the first permanent premolar, p^1, which, as in perhaps all other placental mammals, has no deciduous predecessor. The deciduous molars: dm^1, dm^2, dm^3, (marked dp^2, dp^3, dp^4) show the shelf-like development of the internal cusps (corresponding to the proto- and hypocones of the true molars) and the progressive molarization of the deciduous series, the last being completely molariform. The first true molar is seen in association with the deciduous molars.

In this figure the cusps of the deciduous molars were originally named in accordance with the system devised by Professor Scott for the permanent premolars: the anteroexternal cusp being named "protocone" (pr), the anterointernal cusp "deuterocone," the posteroexternal "tritocone" and the posterointernal "tetartocone." In the present work the cusps of the deciduous molars are named in accordance with the system devised by Professor Osborn for the true molars.

cusps in the anterior premolars are all very widely distributed or even universal characters among mammals that possess a deciduous dentition. I base these statements upon a comparison of the deciduous and permanent dentitions in the following groups: Marsupialia Didelphyidæ; Insectivora (various families as figured by Leche); Creodonta, Triisodontidæ (*Pachyæna*[1]), Mesonychidæ (*Dissacus*[1]), Hyænodontidæ (*Hyænodon,* figured by Leche), Oxyænidæ (*Patriofelis*); Fissipedia: Cat, Dog, Badger, and Leche's excellent figures of the Viverridæ, Mustelidæ, Hyænidæ, Protelidæ; Primates, Adapidæ (figured by Stehlin), Cercopithecidæ, Simiidæ, Hominidæ; Perissodactyla: Eocene and Oligocene Titanotheres, other Eocene Perissodactyls of several families, (figured by Stehlin); Artiodactyla: Eocene families (figured by Stehlin), Tragulidæ, Suidæ; Tillodontia (*Esthonyx*[1]); Tæniodonta, (*Onychodectes*[1]).

The evidence obtainable from the deciduous dentition seems therefore to harmonize with the premolar analogy theory and to indicate that the "protocone" is a derived and not a primary cusp.

The view that one of the outer cusps (especially the paracone) and not the protocone represents the summit of the reptilian upper molar is fully in accord with the embryological facts[2] observed by Röse in the human teeth, by Taeker in the teeth of ungulates, by Leche in the teeth of marsupials and especially by M. F. Woodward in the teeth of various Insectivora. The latter author in discussing the conditions in the Insectivora, writes: "If the protocone represents the summit of the original protodont tooth of the ancestor of the Mammalia it must be the direct continuation of the primitive dentinal germ, and as such should be found to develop in a line with the axis of that structure. That this is not the case is well seen in Fig. 32, Pl. XXVI, [developing upper molar of *Talpa*] where the paracone is found to be identical with the primitive dentinal germ, and the protocone appears as a mere internal ledge growing out from the base of this structure, the metacone and subsequently the hypocone being similarly derived from a backward extension of the base of the primitive dentinal germ."

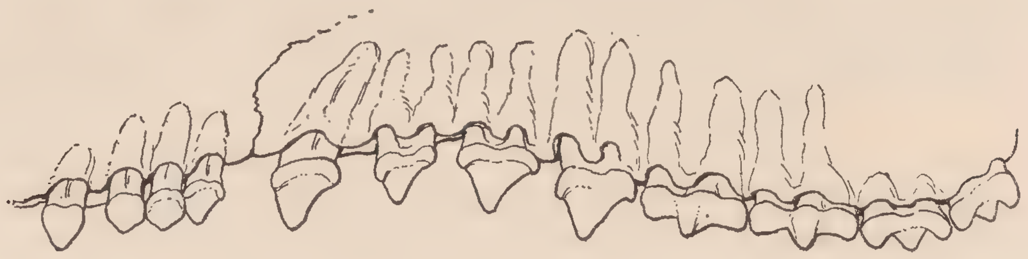

Fig. 5. Upper teeth of a small polyprotodont Marsupial (*Antechinomys laniger*). External view. × $\frac{3}{1}$.

The canine, premolars and molars all have two large external roots, as in all primitive mammals.

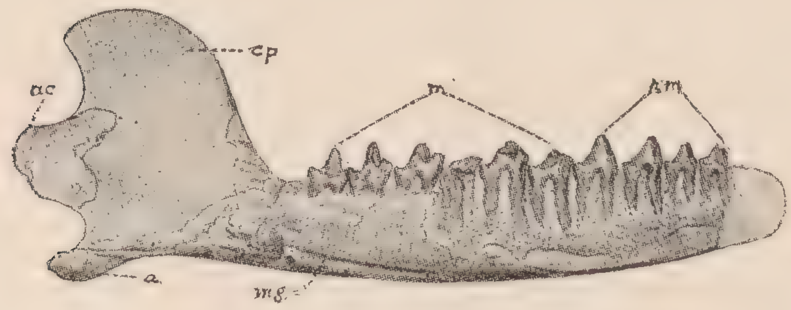

Fig. 6. Lower jaw of *Amphitherium prevostii*, Jurassic, England. From Osborn, after Goodrich. × *circa* $\frac{5}{2}$.

Showing the two roots of the premolars and molars, the conical compressed premolars and the very primitive tuberculosectorial molars.

While this shelf-like development of the protocone might by itself fall under the suspicion of being cænogenetic, it perhaps gains in value when taken in connection with other evidence.

In both the upper and lower jaws the premolars and molars have two external roots (Figs. 5, 6). This is true not only in all the known Mesozoic genera, belonging to several families of the Orders Triconodonta and Trituberculata, but also in all or most primitive mammals, both placentals and marsupials. The internal root, together with the protocone of the upper molars, is sometimes absent but the two external roots are always present in primitive mammals not only in the upper and lower premolars and molars but also in the deciduous molars.

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[1] By courtesy of Mr. Walter Granger.

[2] A summary of the embryological evidence is given in Osborn, 1907, pp. 208–215.

In the lower deciduous molars (Fig. 7) the main *outer* cusp, or protoconid, appears to be the oldest part of the crown, while the inner cusps (paraconid, metaconid, entoconid) appear to have arisen as upgrowths from the internal basal ledge.

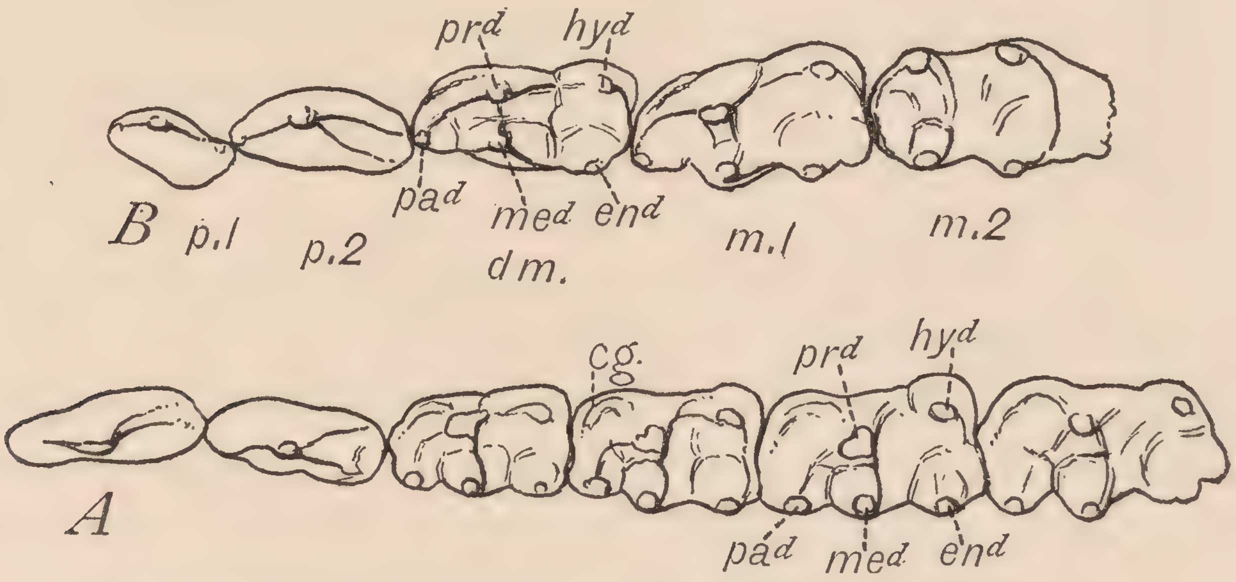

Fig. 7. A. Lower premolars and molars of *Didelphis* sp.
The protoconids of the lower molars appear to represent the tip of the premolars.
cg., anteroexternal cingulum, bordering a fossa for the tip of the enlarged metacone.
B. Deciduous molar and four permanent teeth of *Marmosa chapmani* Allen, a small Didelphid.
The deciduous molar (*dm*) is more molariform than the premolar which replaces it.

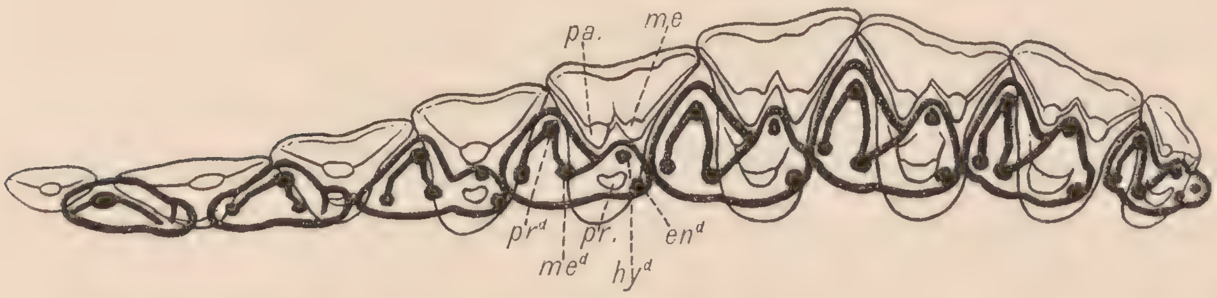

Fig. 8. Diagram illustrating progressive complication of the premolar-molar series and the interlocking relations of the upper and lower teeth in a generalized mammal.

The crown pattern of the lower teeth is shown in heavy black lines.

This diagram does not represent any particular genus, but is based upon the conditions observed in many early Tertiary mammals. With regard to the number of the teeth the diagram represents a hypothetical Mesozoic mammal with four premolars and five molars. The talonids of the lower molars are represented as being narrow, as they are in *Amphitherium* and other Mesozoic mammals. In most Tertiary mammals the talonids are wide.

When the upper and lower cheek teeth of any primitive mammal are carefully studied in articulation it is seen that the single conical cusp of the lower premolars and the protoconid of the lower true molars and deciduous molars correspond in function and topographic relations not with the "protocones" of the upper molars but with the main outer cusp or cusps of the upper premolars and molars, namely with the cusps which are supported by the two external roots.

I have long studied these interlocking relations of the upper and lower cheek teeth in many Tertiary and modern families, especially among the Marsupials, Insectivores, Carnivores, Primates, primitive Perissodactyls, Taligrada, Rodents etc. and I am confident that they lend strong support to the views long since expressed by Fleischmann, Schlosser and others to the effect that the mammalian jaws were originally anisognathus, (namely having the upper cheek teeth overhanging the lower cheek teeth), that the upper and lower cheek teeth originally alternated or interlocked and that the outer side of the upper molars is phylogenetically older than the inner side (Fig. 8).

But while I am thus obliged to reject the fourth proposition of the Cope-Osborn theory of trituberculy, to the effect that the protocones of the upper molars represent the original tip of the reptilian molar crown, yet the transverse widening of the crown or ingrowth of the protocone must have been effected at a relatively early epoch, since it is fully developed not only in the Paleocene and Eocene placental mammals but also in the Upper Cretaceous marsupials.

Whether the main internal cusp of the upper molars of the Jurassic genera *Peralestes* (Plate I, E, K), *Dryolestes, Kurtodon,* represent the protocones of later mammals or whether they are homologous with one of the main outer cusps (para-, metacone) is a difficult question. By analogy with the Paleocene zalambdodont genus *Palæoryctes* and with later zalambdodonts they appear to represent the paracone series, while the internal cingulum indicated in Professor Osborn's figure of the upper molars of *Dryolestes* may represent the beginning of the protocone. The upper teeth of *Peralestes* suggest those of *Didelpys* and from a study of the interlocking relation of the upper and lower teeth in *Didelpys,* I infer that here the metacone represents the tip of the original two-rooted tooth (Plate I, Fig. M).

It may be objected that the trigonal and tuberculo-sectorial molar pattern may also have been attained in different ways among the Placental mammals, but to this I would reply that, notwithstanding contrary opinions, present evidence, in my judgment, points to the monophyletic origin of all the true Eutheria (namely the Carnivora, Ungulates, Primates, Insectivora), the ancestral stock probably having a dental formula, in the adult, of $\frac{3.1.4.3}{3.1.4.3}$, trigonal upper molars and tuberculosectorial lower molars. The molar and premolar patterns of all Eocene Carnivora, Ungulates and Primates show so many and detailed evidences of a fundamental unity of origin that I know no good evidence for the view that in the earliest representatives of the different orders these patterns are merely homomorphic, or homoplastic, and not truly homologous. Later Eutherians sometimes exhibit convergent evolution between adjacent premolars or between premolars and molars, but this is far from disproving that all the primitive ancestral Eutheria of the Cretaceous had premolar and molar patterns which were severally homologous throughout the series.

Without going further into the controversy over the question of the origin of the tritubercular molar, which is still a very debatable matter, it may be noted here that the convenience and usefulness of the Osbornian nomenclature in expressing cusp homologies and homomorphisms in different families and orders of mammals has been recognized by the majority of palæontologists, especially in this country. But many zoölogists, anthropologists, anatomists and especially odontologists, are still without knowledge of the fact noted above that in the Paleocene and Eocene most of the known families of Eutherian mammals exhibit varieties of molar patterns which are very plainly and demonstrably modifications of the primitive tritubercular, or more properly trigonal, type. Nor do they realize, apparently, that the progressive changes in the premolars and molars of Creodonts, Condylarths, Primates, Insectivores, Perissodactyls, Artiodactyls and some other orders, in very many cases have long been quite well understood by American palæontologists.

I am aware that the primitive trigonal pattern is almost obliterated in not a few phyla, and that sometimes similar molar types are produced in different ways and involve partly non-homologous cusps, as where the postero-internal cusp of the upper molars is built up from the enlarged metaconule, as in many Artiodactyls, rather than from the basal cingulum, in the more typical manner. But in spite of such exceptions the Osbornian nomenclature of the molar cusps does in very truth provide the means of identifying homologous cusps in the diversely modified molars of Tertiary and modern mammals, as I will undertake to convince any fair-minded critic who will spend an hour with me in going over the Eocene mammals in the American Museum. Hence I object emphatically to the statements of Dr. Marett Tims in the last edition of Tomes "Dental Anatomy" (1914, p. 384) that although the Cope-Osborn system has "reduced to order" the nomenclature of the complex molar teeth of ungulates, yet "the reduction to order here referred to is unfortunately now again reduced to disorder. The terms Protocone, etc., may still be used to denote certain cusps, but certainly not with an assured implication of morphological significance, such as was intended when the terms were first adopted."

I deplore also the tendency of some writers to abandon the well established usage of the tritubercular nomenclature and to invent more or less clumsy substitutes. What does it matter except to minds spoiled by a too literal use of words if the protocone was not the "apex of the original reptilian crown?" No matter how or when it arose, the protocone is the name for that cusp of the upper molars which in primitive mammals forms the main internal, or lingual, projection of the crown and which fits into the talonid of the lower molars (Fig. 9). The protoconid, on the other hand, originally wedges in between two upper molars (Fig. 8). Thus the protocone is as well defined a morphological concept as the sella turcica, or the entepicondylar foramen, and the same is equally true of all the other well recognized parts of the mammalian molars, as originally named by Osborn.

Hence it is not likely that American palæontologists will soon give up this convenient system for the at least equally cumbersome and hypothetical systems recently proposed by Bolk (1914) and extended by Schwalbe (1915).

Anthropologists and experimental zoölogists have diligently spread the thoroughly fallacious doctrine that morphology must be made an "exact" science and that results must be expressed in tables of indices and algebraic symbols. But, without disparaging the use of indices etc. as a method of describing facts, I often find it preferable to compare satisfyingly concrete and specific facts rather than abstract general symbols, and it seems far easier to call up a fairly distinct image of the second lower molar in *Pelycodus* than to remember that the cusp formula of this tooth according to Bolk is $\frac{\mathrm{Pa\ Pp\ 2}}{\mathrm{3\ D\ 4}}$. This means in plain English only that all the cusps of the primitive tuberculo-sectorial lower molar are present, but gives no clue to the actual form of these cusps or to the precise appearance of the molar pattern, which are features of much practical importance.

But this is not to deny that Professor Bolk's system is easy to learn and that under certain circumstances it may be of real service. For example, the mere statement that the tuberculo-sectorial type of lower molar is the primitive pattern for Paleocene and Lower Eocene Eutherians may make but little impression upon opponents of the theory of trituberculy, but if I were to fill several quarto pages with the names of the Eocene genera and species (of many orders and families) in which the tuberculo-sectorial molar is present, and if I were to give the full Bolkian cusp formula for each molar, I dare say the resulting array of columns would be respectfully examined by anthropologists, statisticians and modern zoölogists.

In conclusion, I continue to endorse the Cope-Osborn theory, in so far as it derives all the more complex molar patterns of typical placental mammals respectively from the "tritubercular" and "tuberculo-sectorial" types of upper and lower molars. But I am forced to reject that theory both in its explanation of the origin of the tritubercular type and in its identification of the protocone as the summit of the haplodont reptilian molar. On the

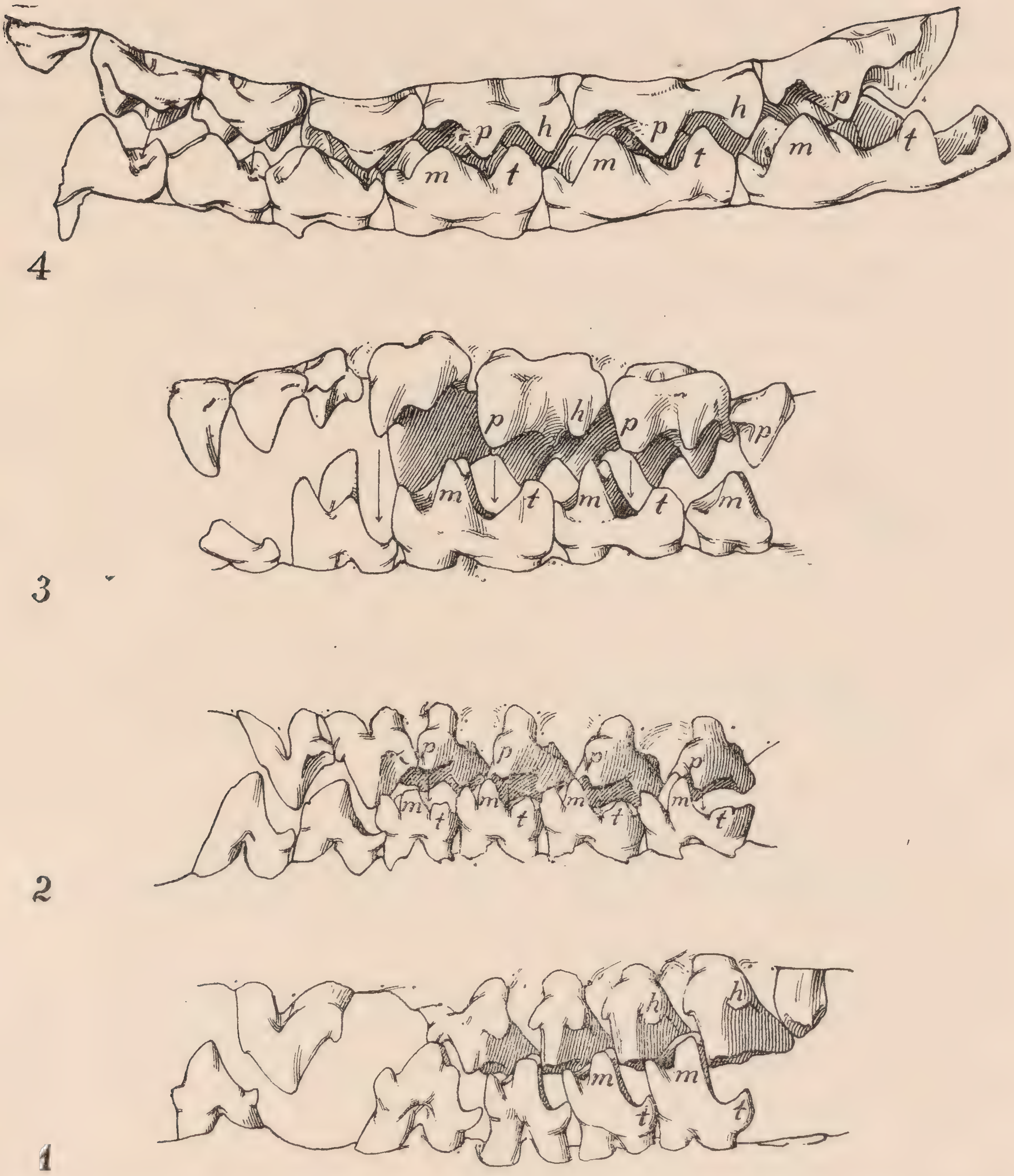

Fig. 9. Interlocking relations of the right upper and lower premolars and molars. Internal or lingual side view. (After W. K. Gregory in Osborn's "Evolution of the Mammalian Molar Teeth," 1907).

1. *Centetes* (Ord. Insectivora, subord. Zalambdodonta).
   A specialized insectivorous-carnivorous type. This is not a primitive tritubercular type. The paracone (*p*) has grown inward and nearly usurps the position of the protocone.
2. *Didelphys* (Ord. Marsupialia, subord. Polyprotodontia).
   Primitive insectivorous-omnivorous adaptations. A primitive marsupial with tritubercular upper molars and tuberculosectorial lower molars. The protocones (*p*) fit into the basin of the talonids (*t*). The trigonids fit between two adjacent upper teeth. *m*, metaconid.
3. *Erinaceus* (Ord. Insectivora, subord. Erinaceoidea).
   Progressive insectivorous-omnivorous adaptations. The anteroposterior diameter of the molars has increased. The wide protocones fit into the broad talonid basins. The hypocones (*h*) jut inward into the basin of the trigonids of the lower molars.
4. *Telmatherium* (Ord. Perissodactyla, Fam. Brontotheriidæ).
   Herbivorous adaptations. Marked increase in anteroposterior diameters of the cheek teeth, the upper molars now including widely separated anterior and posterior moieties. Correlated expansion of the talonid basins. Premolars becoming submolariform.

other hand I now accept, in the main, the "Premolar-Analogy" Theory, as advocated especially by Wortman and by Gidley, which holds that the paracone of placental mammals usually represents the summit of the originally haplodont crown and that the protocone is an outgrowth from the inner base of the crown.

2. *Application of the "Theory of Trituberculy" to the Molar Patterns of Primates.*

In 1888 Professor E. D. Cope, in his article "On the Tritubercular Molar in Human Dentition,"[1] maintained that "first, the quadritubercular type of molar crown, illustrated by the first superior true molar of man, belongs to the primitive form from which all the crest-crowned (lophodont) molars of the hoofed placental mammals have been derived; and second, this quadritubercular type of molar has itself been derived from a still earlier, tritubercular crown, by the addition of a cusp at the posterior internal part of it.... In the inferior series," Cope continues, "I have shown that in known placental mammalia at least, the primitive molar crown is quinquetubercular, or tritubercular with a posterior heel."

In particular Cope held that the upper and lower molar patterns of man had been derived from the tritubercular, tuberculosectorial type exhibited in the Lower Eocene lemuroid *Anaptomorphus*. "This is the genus of Lemuroidea," he said, "which in its dental character most nearly approaches the anthropoid apes and man." Cope noted that the upper molars of man vary from the quadritubercular to the tritubercular condition, and he regarded the tritubercular form of human molars as a "reversion to the dentition of the Lemuridæ of the Eocene period of the family of Anaptomorphidæ." Cope's views will be discussed below. They are cited here in order to show that the Cope-Osborn theory of trituberculy was early applied to the elucidation of the morphology of the human molars.

In 1907 Professor H. F. Osborn[2] (pp. 157) said: "Cope's contention as to the tritubercular origin of the teeth of Primates rested upon the strongest possible proofs both from comparative zoölogy and from palæontology. The tritubercular pattern is still the prevailing one among the Lemuroidea, while the Anthropoidea radiate from trituberculy into quadrituberculy, and into crested forms. Osborn's recent revision[3] of the American Eocene Primates proves that the molars exhibit a fundamentally triangular pattern in every one of the twenty-two or more known species. The various types exhibit a familiar succession of stages from a more triangular condition with an extremely rudimentary hypocone to a quadrate, sexitubercular condition, stages which have already been treated in the evolution of the human molar teeth." (Fig. 10).

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[1] Journal of Morphology, Vol. II, July 1888, pp. 7–23, pl. ii, iii.

[2] Evolution of Mammalian Molar Teeth to and from the Triangular Type. New York, 8vo, 1907.

[3] Bull. Amer. Mus. Nat. Hist., Vol. XVI, 1902, pp. 169–214.

Professor Bolk, although attacking the theory of trituberculy at almost every point, has arranged a beautiful series of diagrams of the upper molar patterns in recent Primates, which series perfectly illustrates Professor Osborn's remark that "The tritubercular pattern is still the prevailing one among the Lemuroidea, while the Anthropoidea radiate from trituberculy into quadrituberculy, and into crested forms."

Professor Bolk's diagrams also illustrate a principle of dental mechanics which I described in 1910 (p. 188) and have since found to have a wide application: namely, that in the evolution of omnivorous, herbivorous and certain other types of molars the anteroposterior diameter of the whole crown steadily increases and all the main cusps widen anteroposteriorly, until an originally narrow trigonal upper molar of insectivorous type is transformed into an anteroposteriorly widened and more or less quadrate crown, with approximately similar anterior and posterior moieties (Fig. 9); meanwhile the lower molars enlarge the talonid and often lose the paraconid and the basin of the trigonid. Such a transformation may be followed in many families of Insectivores, Creodonts and Ungulates and is well illustrated in the comparison of the molar patterns of primitive Lower Eocene Primates with those of later Primates, as shown in the accompanying figures.

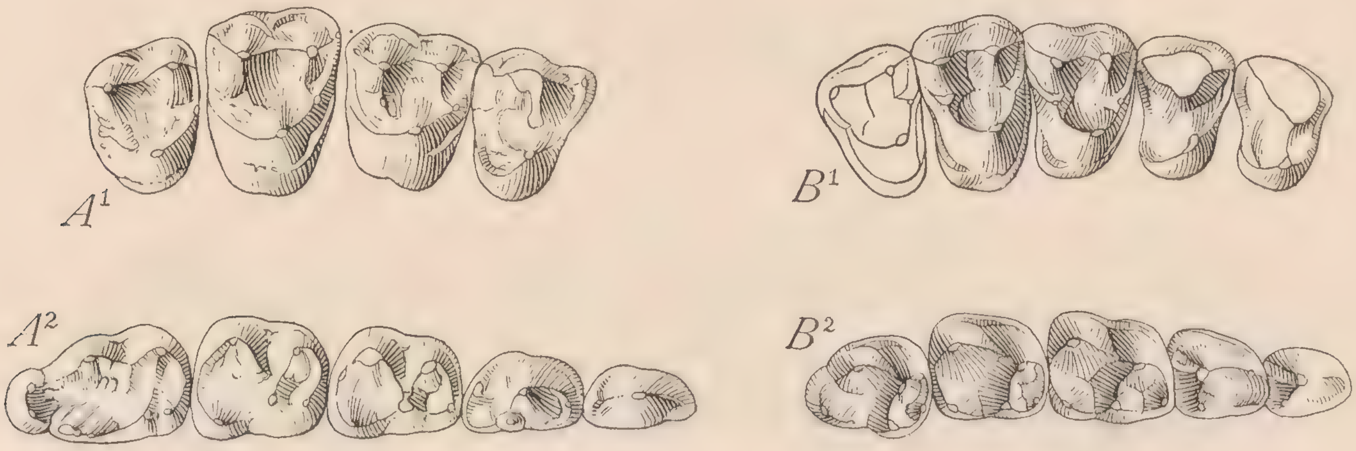

Fig. 10. Upper and lower premolars and molars of two primitive North American Eocene Primates representing the families Adapidæ (A^1, A^2) and Tarsiidæ (B^1, B^2), exhibiting the primitive tritubercular upper molars and tuberculosectorial lower molars.

A^1, A^2. *Pelycodus trigonodus.* Lower Eocene, Wyoming. After Matthew. $\times \frac{2}{1}$.

B^1, B^2. *Omomys* sp. Middle Eocene, Wyoming. After Matthew. $\times \frac{2}{1}$.

In all primitive mammals the trigonid of the lower molars wedges inside and between two adjacent upper molars (Fig. 11A) and the space between these molars is progressively obliterated by the widening of the inner side of the crown. In such manner the primitive tuberculo-sectorial lower molar, which is provided with small cutting blades and sharp points for an insectivorous diet, is transformed into a bluntly cusped, crushing molar adapted for omnivorous or for herbivorous diet.

In the lower Primates the interlocking and alternating relations of the upper and lower molars constitutes a primitive condition seen in all primitive mammals and even plainly foreshadowed in *Bauria, Galesaurus, Sesamodon, Diademodon* and other Cynodont reptiles. In modern man, however, the interlocking alternating arrangement is usually more or less replaced by a condition in which each lower molar articulates with only one upper molar (Fig. 11D). In some human skulls, however, the greatly reduced trigonid of the lower molars still retains a good contact with the posterior side of the upper molars, as observed by Topinard (1892) and others (Fig. 11C). Intermediate conditions are seen in the anthropoid apes (E).

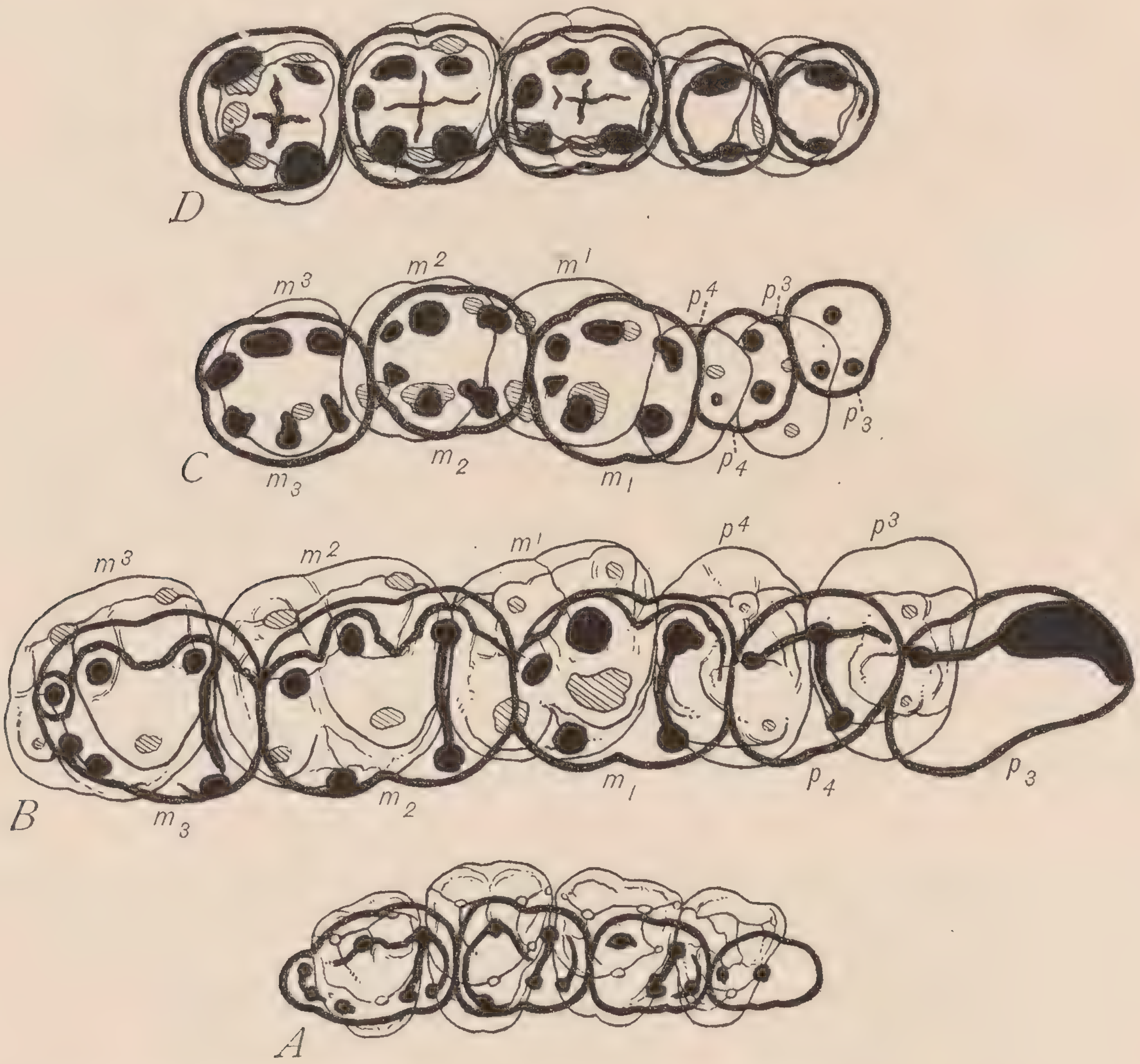

Fig. 11. Interlocking relations of the upper and lower cheek-teeth.

A. *Pelycodus trigonodus*, a Lower Eocene lemuroid with primitive premolar and molar patterns.

B. *Gorilla* sp.

C. *Homo sapiens* (Australian black), with alternating or interlocking relations between the upper and lower molars.

D. *Homo sapiens* (Negro), with end-to-end relations of upper and lower molars.

Thus the molars of all Primates including man are believed to have

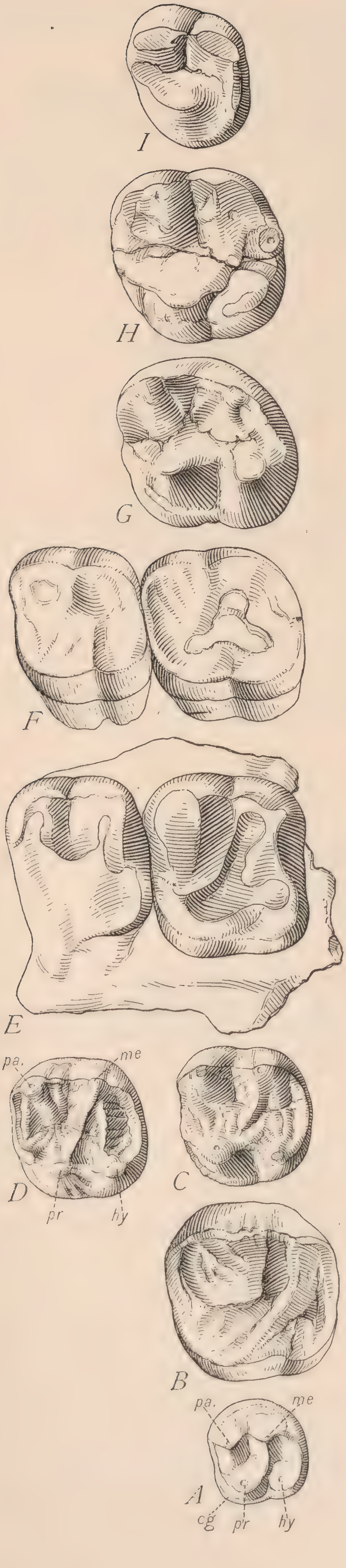

Fig. 12. Comparative series showing chiefly the second left upper molar in Hominidæ and Tertiary anthropoids. Three times natural size.

A. *Pliopithecus antiquus* m^2. Upper (?) Miocene of Göriach, Austria. After Hoffman.
B. *Dryopithecus punjabicus* m^2. Upper Miocene of Haritalyangar, India. After Pilgrim.
C. *Pan* (*Anthropopithecus*) sp. Recent chimpanzee (m^1).
D. *Dryopithecus rhenanus*. Lower Pliocene Bohnerz of the Swabian Alps. From a cast. (m^1).
E. *Sivapithecus indicus*. Referred m^1, m^2, much worn. From the Upper Miocene of Haritalyangar, India. After Pilgrim.
F. *Palæopithecus sivalensis* m^1, m^2, much worn. From the Pliocene of Jobi, India. After Dubois.
G. *Homo neanderthalensis* m^2. From the Pleistocene of Krapina. After Gorganovic Kramberger.
H. *Homo sapiens* m^2. Kaffir from South Africa.
I. *Homo sapiens* m^2. Brachycephalic Caucasian.

In the more primitive members of the series (A–D) the primitive trigon, consisting of the protocone, paracone and metacone, is reinforced by the large hypocone, which in *Homo neanderthalensis* becomes extremely prominent, the anteroposterior diameter of the crown having meanwhile increased. In the final stage (I), in correlation with the shortening of the whole tooth row and with the retrogressive character of the dentition, the hypocone disappears, and the small crown assumes a pseudo-tritubercular form.

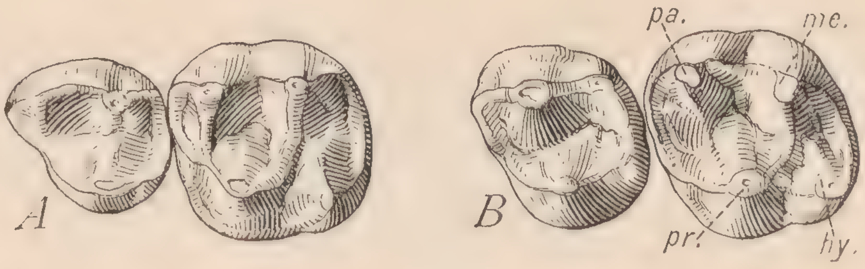

Fig. 13. Superior deciduous molars of a chimpanzee (A) and of *Homo sapiens* (B), showing agreement in fundamental pattern. The last deciduous molar as in all other mammals is molariform. × $\frac{3}{2}$.

been derived ultimately from simple trigonal upper molars and tuberculo-sectorial lower molars (Fig. 10). The tritubercular upper molars of modern men are probably of retrogressive form (Fig. 12). The quadritubercular upper molars of lower and Pleistocene races clearly lead back through the quadritubercular molars of mid-Tertiary anthropoids to the trigonal, tritubercular molars of the earliest Eocene lemurs as will be shown more fully in Part II.

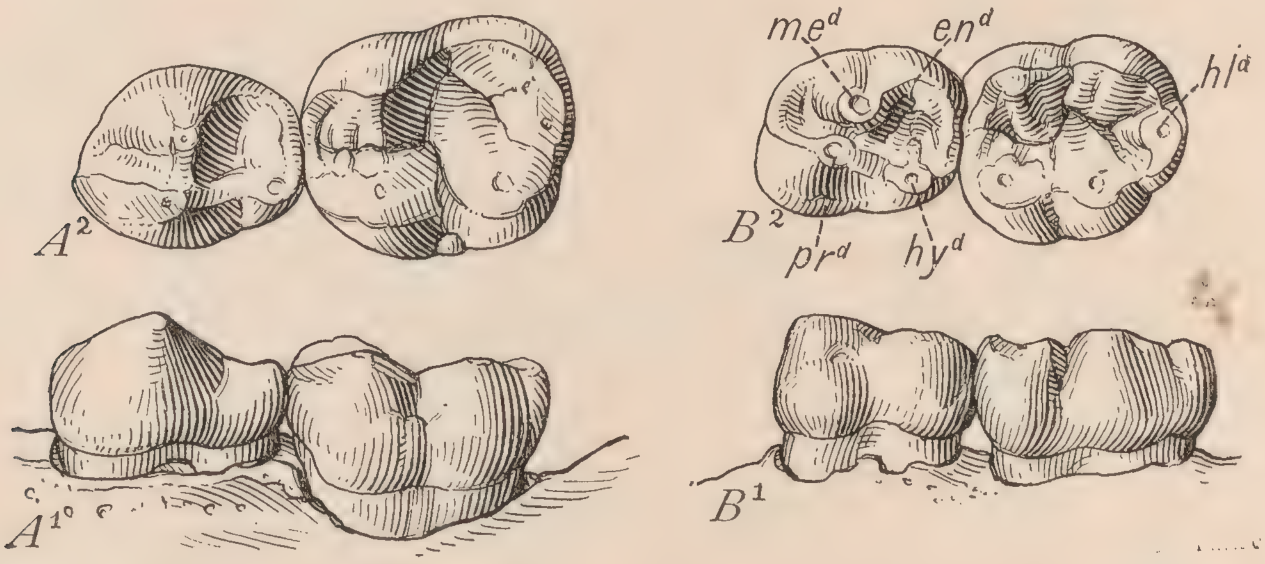

Fig. 14. Inferior deciduous molars of a chimpanzee (A^1, A^2) and of *Homo sapiens* (B^1, B^2) showing agreement in fundamental pattern.

As in the case of the upper deciduous molars, the anterior lower one in man is more molariform than in the chimpanzee, which thus retains a more primitive pattern in this tooth, as in others. × $\frac{3}{2}$.

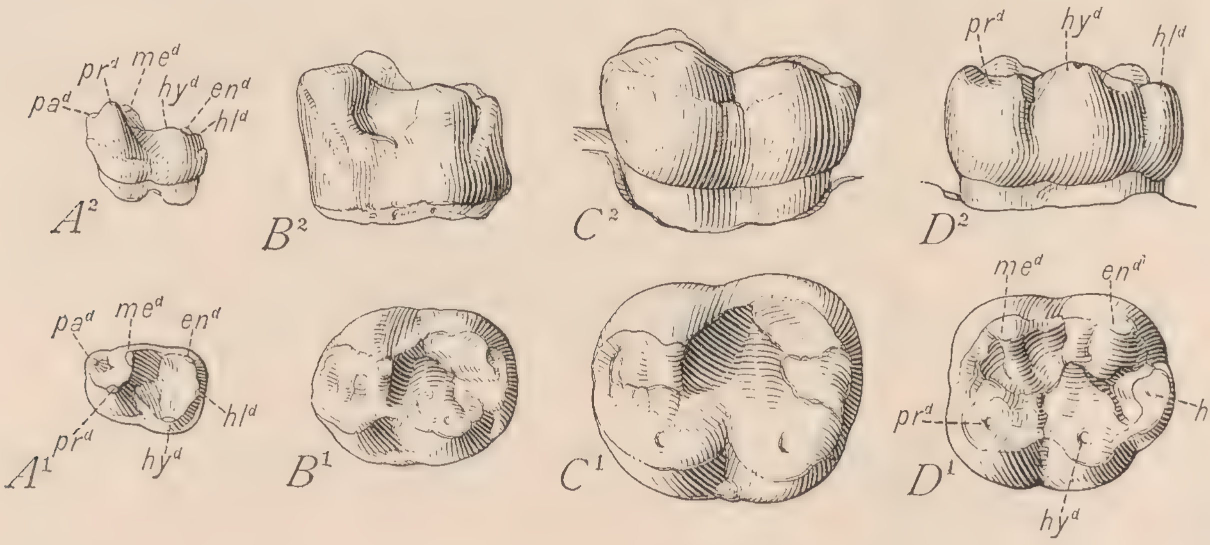

Fig. 15. Last lower deciduous molar of *Homo sapiens* (D), Chimpanzee (C), *Dryopithecus rhenanus* (B) (from a cast); compared with a permanent molar of an Eocene tarsioid (*Omomys*).

A^1, A^2 × $\frac{3}{1}$; remaining figures × $\frac{3}{2}$.

In man (D) the tuberculosectorial pattern of the last lower deciduous molar is disguised, but in *Dryopithecus* it was largely retained.

Comparison of the upper and lower molar patterns, both in the deciduous and permanent series, furnishes clear evidence that man is nearly allied to the Mid-Tertiary genera *Sivapithecus* and *Dryopithecus* and more remotely to the existing Chimpanzees and Gorillas (Figs. 11–15).

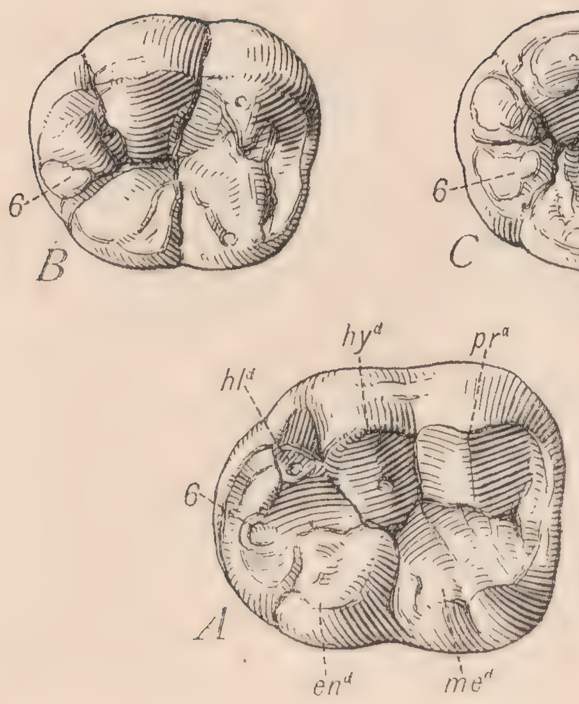

Fig. 16. Anthropoid heritage in the lower molar pattern of Man. All figures × $\frac{3}{2}$.

A. *Dryopithecus chinjiensis.* Upper Miocene, India. Left m_3. After Pilgrim.

B. *Homo sapiens.* Left m_1, from the mandible of an Indian child.

C. *Homo sapiens.* Left m_1 of an adult Australian black (♀).

In the primitive anthropoid (A) the molar crown is elongate, the posterior moiety is not wider than the anterior moiety and the entoconid is relatively small. In Man the opposite proportions are usually found. But the pattern of the crown in primitive human types is fundamentally the same as in *Dryopithecus* and *Sivapithecus*, consisting of five and sometimes six cusps arranged in the same manner. The main furrows also are arranged in much the same way, except that in Man, through the great enlargement of the entoconid the furrow that bounds the hypoconid internally is more or less excluded from contact with the base of the metaconid. In specialized human types the lower molars often lose the hypoconulid and also the sixth cusp (6); they become more or less rounded or subcircular in outline and the main furrows often tend to arrange themselves thus: + (Fig. 11, D).

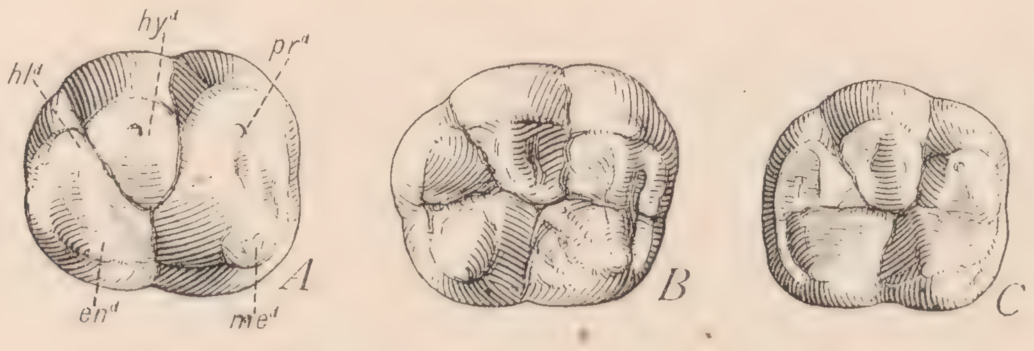

Fig. 17. Anthropoid heritage in the lower molar pattern of Man (cont'd).

A primitive first lower molar of man (B), compared with that of two Miocene anthropoids, (A) *Sivapithecus indicus* Pilgrim (drawn from a cast of the type specimen) and (C) *Dryopithecus chinjiensis*, after Pilgrim.

All figures × $\frac{3}{2}$ nat. size.

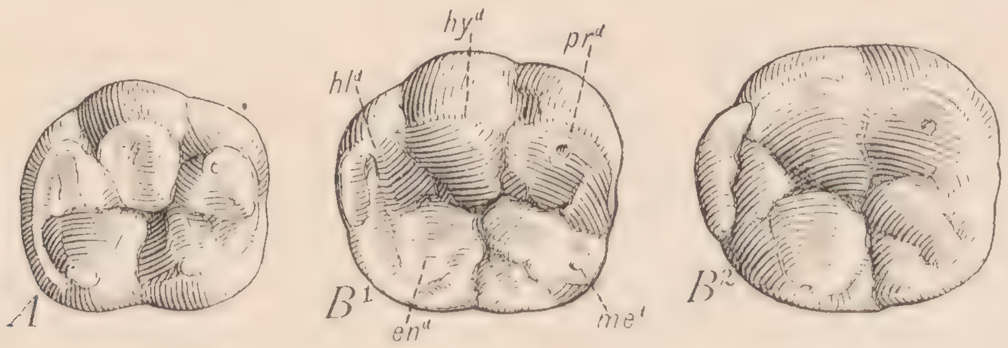

Fig. 18. B^1, B^2, two figures of the fossil human molar (left m_1) discovered by the Selenka expedition near Trinil, Java.

B^1 after Deek, B^2 after Walkhoff.

A. *Dryopithecus chinjiensis*, after Pilgrim. Upper Miocene, India.

All figures × $\frac{3}{2}$ nat. size.

The human molar seems to agree in general characters with the first lower molar of *Homo heidelbergensis* (Part II, fig. 27, E), but the variation in form among human molars is so great that perhaps no special significance should be attached to this fact.

PART II.—PHYLOGENY OF RECENT AND EXTINCT ANTHROPOIDS, WITH SPECIAL REFERENCE TO THE ORIGIN OF MAN.

CONTENTS.

PAGE.
I. Introduction 258
II. Chief Adaptive Characters of the Skull, Dentition and Limbs of the Recent Anthropoids and Man 272
III. The Fayûm Oligocene Anthropoids 280
  Parapithecus 280
  Propliopithecus 284
IV. The Siwalik Upper Miocene and Lower Pliocene Anthropoids 285
  Palæosimia 286
  Sivapithecus 287
  Dryopithecus 293
  Palæopithecus 299
V. The Extinct Anthropoids and Men of Europe; also *Pithecanthropus* . . 301
  Pliopithecus 301
  Dryopithecus 305
  Neopithecus 310
  Anthropopithecus (Pan) 313
  Pithecanthropus 320
  Homo 321
VI. Phylogenetic Summary and Conclusions 336
  1. Phyletic Relations of the Tertiary and Quaternary Anthropoids 336
  2. Origin of the Recent Anthropoids 338
  3. The Origin of Man 341
  4. On the evolution of food habits of the Hominidæ during the later Tertiary, and early Quaternary periods 342
  5. Appendix A. M. Boule's Conception of *Eoanthropus* and of the ancestral Hominidæ 345
  6. Appendix B. Note on the Association of the Piltdown Skull and Jaw. By W. D. Matthew 348
VII. Bibliography of Parts I, II 351

I. INTRODUCTION.

The important collection of American Eocene Primates in this Museum has already been worked over, chiefly for the purpose of identifying the genera and species therein represented, by President Osborn (1902) and more recently by Doctor Matthew (1915). In 1912 these gentlemen generously entrusted to me the fuller study and description of this precious material, from the morphological and phylogenetic viewpoints, and they have also suggested that I should study the order of Primates as a whole, for the purpose of attaining some broad conception of the course of evolution and genetic relationships of its various branches. Accordingly, beginning with the American Eocene family Notharctidæ I compared the skulls and postcranial skeletons of this group, which is well represented in our collections, with corresponding parts of the European Adapidæ and of various genera of recent lemuroids and other Primates. I then extend my studies to the remaining lemuroids, recent and extinct and finally to all the higher Primates. I had the privilege of examining the fossil lemuroid and other Primate material in the British Museum, and from the Museum of Comparative Zoölogy at Cambridge, Mass., I secured, through the kindness of Drs. Henshaw and Allen, the loan of a remarkably preserved specimen of the European Eocene lemuroid *Necrolemur*, which has been of the greatest service; while in this Museum I have at hand, in addition to the Eocene material already mentioned, a fairly representative collection of recent Primate skeletons, and casts of nearly all the important known extinct types of Asia, Africa, Europe and America. The photographs of recent Primate skulls, which had been made by my colleague Mr. A. E. Anderson for the late Dr. D. G. Elliot's great work on the Primates (1912) have also proved of signal value in my studies. About two hundred new illustrations of recent and fossil Primates have also been prepared for the present work with great skill, by Mr. Anderson and Mr. E. S. Christman.

Part I of the present series has dealt with the Cope-Osborn "theory of trituberculy" in its relation to the origin of the molar patterns of the Primates; Part II deals with the phylogeny of the great apes and man; Part III will treat of the catarrhine, or Old World Primates, and of the Platyrrhinæ, or monkeys of the New World; Part IV will discuss the phylogeny of the Lemuroidea and the possible relationships of the order as a whole with other mammalian stocks. Preliminary abstracts from the section on the Lemuroidea have already been published (1915).

A new synthetic study of the Primates seems timely because of the great additions that have been made during the last two decades to the material or objective side of our knowledge of the Primates. For during this period the Eocene lemuroids have been revised by Osborn (1902), Wortman (1903–1904), Stehlin (1912), and Matthew (1915), while new extinct lemurs of Madagascar have been described by Grandidier (1905), Standing (1908), and others. The fossil anthropoids of Europe (which are known chiefly from imperfect jaws and isolated teeth originally described by Gervais, Gaudry, Hoffman, Branco and others) have been restudied by Schlosser (1900, 1903), and Abel (1902), and the palæontological history of this group has been recently extended by the discoveries of Pilgrim (1915) in India and of Schlosser (1911) and Strömer in Egypt. Meanwhile great progress has been made in the knowledge of Pleistocene races of man, especially through the labors of Gorganovíc-Kramberger (1906), Schœtensack (1908), Boule (1912), Schwalbe (in numerous studies), Smith Woodward (1913), Keith (1915) and others. I have naturally had recourse also to the well-known writings of Mivart, Forsyth Major, Dubois, Schlosser, Selenka and Winge and to the iconographic works of DeBlainville, Cuvier and Laurillard (Planches de Myologie, 1849) and especially the great monograph by A. Milne Edward and A. Grandidier (1875) on the anatomy of the Indrisinæ. This work is illustrated by 122 superbly executed plates, many of them in color, which set an almost unattainable standard for subsequent works of this character. In studying the morphology of the base of the cranium, including the architecture of the auditory region and the course of the internal carotid artery and its branches (regions and structures which afford pattern-complexes of high phylogenetic significance) I have thoroughly considered the important observations of Tandler (1899–1902), van Kampen (1905) and Zuckerkandl (1899).

But in spite of, or perhaps because of, all this wealth of material, there is still divergence of opinion regarding the classification of the major groups of the Primates and even more as to the origin and history of these groups.

In 1903 and 1904 Doctor J. L. Wortman, one of the pioneers of vertebrate palæontology in North America, whose withdrawal from palæontological work has been much regretted by his colleagues, made a notable and highly original attempt to work out the evolutionary relationships of the major groups and to reclassify the order on phyletic lines, as follows:

- Order Primates
  - Primary Division Cheiromyoidea
    - Fam. Microsyopsidæ
    - " Metacheiromyidæ
    - " Cheiromyidæ
  - " " Lemuroidea
    - Fam. Lemuridæ
    - " Indrisidæ
    - " Nesopithecidæ
  - " " Anthropoidea
    - Superfamily Arctopithecini
      - Fam. Hapalidæ
    - " Paleopithecini
      - Fam. Anaptomorphidæ
      - " Tarsiidæ
    - " Neopithecini
      - Fam. Adapidæ
      - " Cebidæ
      - " Cercopithecidæ
      - " Simiidæ
      - " Hominidæ

In the present series of studies the writer will frequently return to this classification of Dr. Wortman's for detailed consideration and criticism. At present, however, it seems advisable to consider it in a broad and preliminary way, chiefly by merely stating the principal points in which it appears to the present writer to be objectionable or erroneous. In criticising Dr. Wortman's classification I shall almost necessarily put forward my own conclusions as to the interrelationships of the major groups of Primates, and thus the reader may be enabled to judge for himself, as these studies appear, how far my criticisms of Dr. Wortman's classification are justifiable and to what extent my conclusions seem to be legitimately drawn from the available evidence.

The first "primary division" Cheiromyoidea of Wortman appears to be an unnatural assemblage and not worthy of the high rank assigned to it. *Cheiromys* (*Daubentonia*) itself is surely a lemur of lemurs, an aberrant relative of the Indrisidæ, as I shall endeavor to show in detail in Part IV, and as most authorities have long held. Next the Metacheiromyidæ are not Primates at all, as shown by both Osborn and Matthew, but Edentates, related to the armadillos, the error having arisen through the malassociation of certain lemuroid remains with parts of a then unknown Edentate. Thirdly, the "Microsyopsidæ" in my judgment show no good evidence of relationship with the Cheiromyidæ. They are Eocene Primates (?) of very doubtful relationships and they resemble *Cheiromys* solely in the fact that they have a pair of enlarged lower front teeth of the gnawing type, a specialization acquired independently in many phyla of mammals and of little value as an indication of relationship.

Doctor Wortman did not, in my opinion, attain a clear conception of the interrelationships of the Lemuroidea, else he would not have omitted from this assemblage the Cheiromyidæ and Adapidæ and would not have failed to set apart the Lorises and Galagos in a family distinct from that of the lemurs of Madagascar, especially as he has given full family rank to the Indrisidæ and also to their near allies the Nesopithecidæ.

Even less fortunate it appears, is his treatment of the suborder Anthropoidea. For in assigning to this suborder the family Adapidæ and especially in placing the Adapidæ among the Neopithecini he has joined that which Nature has set far apart, while in removing widely the Hapalidæ from the Cebidæ he has separated two very closely allied descendants of a common ancestral stock. As to the Adapidæ, subsequent discovery may, conceivably, prove that the earliest members of the Notharctine or North American division of this family gave rise to the Platyrrhinæ, or monkeys of the New World. But between all known Adapidæ and all known Anthropoidea there is a wide structural hiatus: in the dentition, in the whole architecture of the base of the skull, and to a less extent in the vertebral column and limbs. On the other hand all the Adapidæ both of America and of Europe are typically lemuriform in the architecture of the skull, save that they have not yet acquired certain minor specializations which have become characteristic of modern lemurs.[1] I conclude therefore that the Adapidæ should be assigned to the Suborder Lemuroidea and that the older North American representatives of the family are the most primitive known lemuroids.

As to the Hapalidæ, I can only state here that nearly all the characters which, according to Dr. Wortman (1904, p. 220) indicate derivation from some early "Paleopithecine apes," are, in my judgment, either retrogressive or specialized characters which do not exclude the Hapalidæ from close alliance with the Cebidæ. Here belong the claw-like form of the nails,

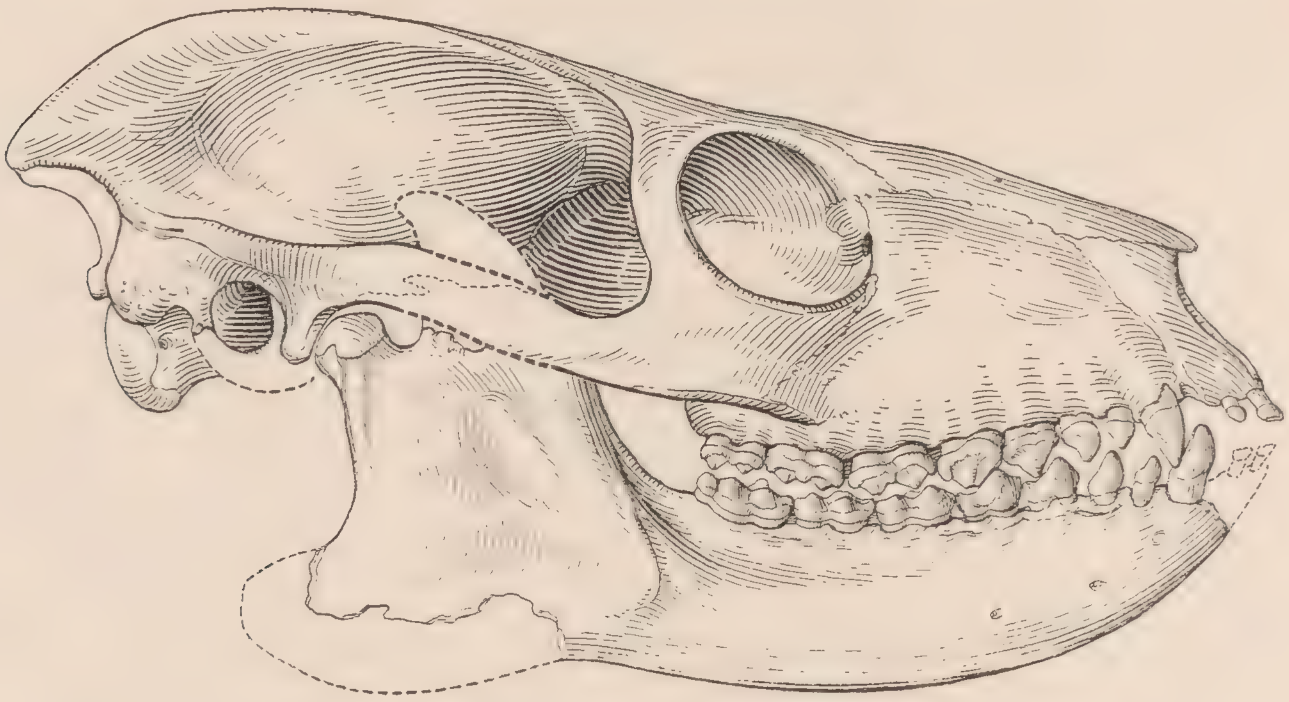

Fig. 1. Skull of an American Middle Eocene lemuroid **Notharctus formosus,** sp. nov.[2] Representing the American branch of the Adapidæ. × $\frac{1}{1}$.

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[1] For a fuller discussion of this matter see the author's paper "On the Relationship of the Eocene Lemur *Notharctus* to the Adapidæ and to other Primates." Bull. Geol. Soc. America, Vol. 26, pp. 419–446, 1915.

[2] *Type,* Amer. Mus. No. 11466, a nearly complete skull and lower jaw from the Middle Bridger Beds, Grizzly Buttes, West; Bridger Basin, Wyoming.

Distinctive characters: Differs from *N. tyrranus, anceps* and *affinis* Marsh in the smaller and more slender lower molars, with narrower talonids; p_1, p_2 spaced (diastemata closed in *tyrannus, anceps* and *affinis*); p_3 shorter than in *anceps,* with small talonid; p_4 with metaconid smaller than in *anceps;* m_3 has the two cusps of the entoconid region very small; paraconid small on m_1, vestigial or wanting on m_2, m_3; external cingula not extending on talonid. Lower canines small, with low crown (a female character?). Symphysis of mandible extends back to middle of p^4. P^4–m^3 with internal cingula weak (well defined in *anceps*). P^4 less progressive than in *affinis.*

Measurements of type.

p_1–m_3,	31.4	p^1–m^3,	27.3
m_1–m_3,	16.6	m^1–m^3,	13.7
m_3a.p.,	6.4		

The Bridger species of *Notharctus* have recently been studied by Mr. Walter Granger and the present writer and our revision of these forms will appear in Part IV of the present series of studies.

the feeble opposability of the hallux and pollex, the tritubercular form of the upper molars and the comparative slenderness of the lower jaw and the forward extension of the lacrymal. As will be argued more fully in Part III of these studies, the whole physiognomy and morphology of the Marmosets prove them to be specialized Platyrrhinæ, widely removed from the *Anaptomorphus-Tarsius* group.

In assigning the Eocene Anaptomorphidæ and the existing Tarsiidæ to the Anthropoidea under the "Superfamily Paleopithecini" Doctor Wortman took a bold course which may eventually be justified by further discovery and investigation. Indeed I shall offer some evidence for the conclusions, first, that *Necrolemur* of the Eocene of Europe, together with its ally *Microchœrus,* form a family Microchœridæ, which should be referred to the Tarsiiformes, and secondly that the known Microchœridæ exhibit certain important characters, not found elsewhere among the Lemuroidea, which may well be looked for in the immediate ancestors of the Anthropoidea, although the Microchœridæ themselves are plainly too specialized to lie in the direct line (*postea,* p. 264). But even if it should eventually be shown that some of the Tarsiiform series (Wortman's Paleopithecini) are allied to the remote ancestors of either the Platyrrhine or the Catarrhine division of the Anthropoidea, it would seem more judicious at present to let this division remain under the Lemuroidea, or even to give it coördinate rank with that group rather than to force it within the confines of the suborder Anthropoidea.

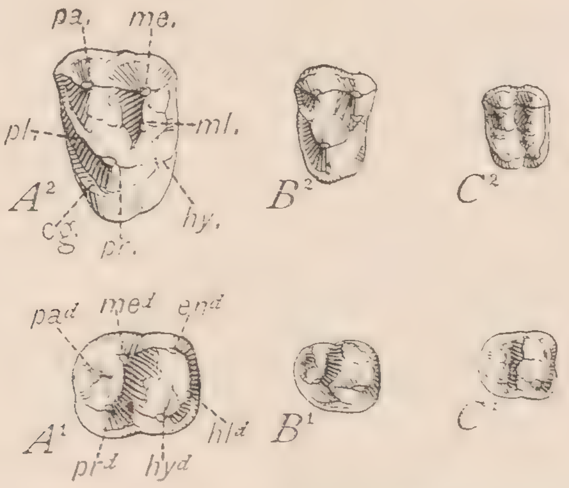

Fig. 2. Upper and lower molar patterns of primitive Eocene lemuroids.
A. *Pelycodus ralstoni.* After Matthew.
Fam. Adapidæ, subfam. Notharctinæ. Lower Eocene, Wyoming.
B. *Omomys* sp. After Matthew. Fam. Tarsiidæ. Middle Eocene, Wyoming.
C. *Necrolemur antiquus.* From the specimen shown in Fig. 3 A.
Upper Eocene, Europe.
All figures × $\frac{2}{1}$.

In A and B the upper molars retain the primitive tritubercular pattern and the lower molars are tuberculosectorial. In C the pattern approaches that of the Catarrhinæ or Old World Primates, since the upper molars have four main cusps, while in the lower molars the paraconid has disappeared and the four main cusps are arranged in two transverse pairs. But these features may well have been independently acquired in the *Necrolemur* group and in the Catarrhinæ.

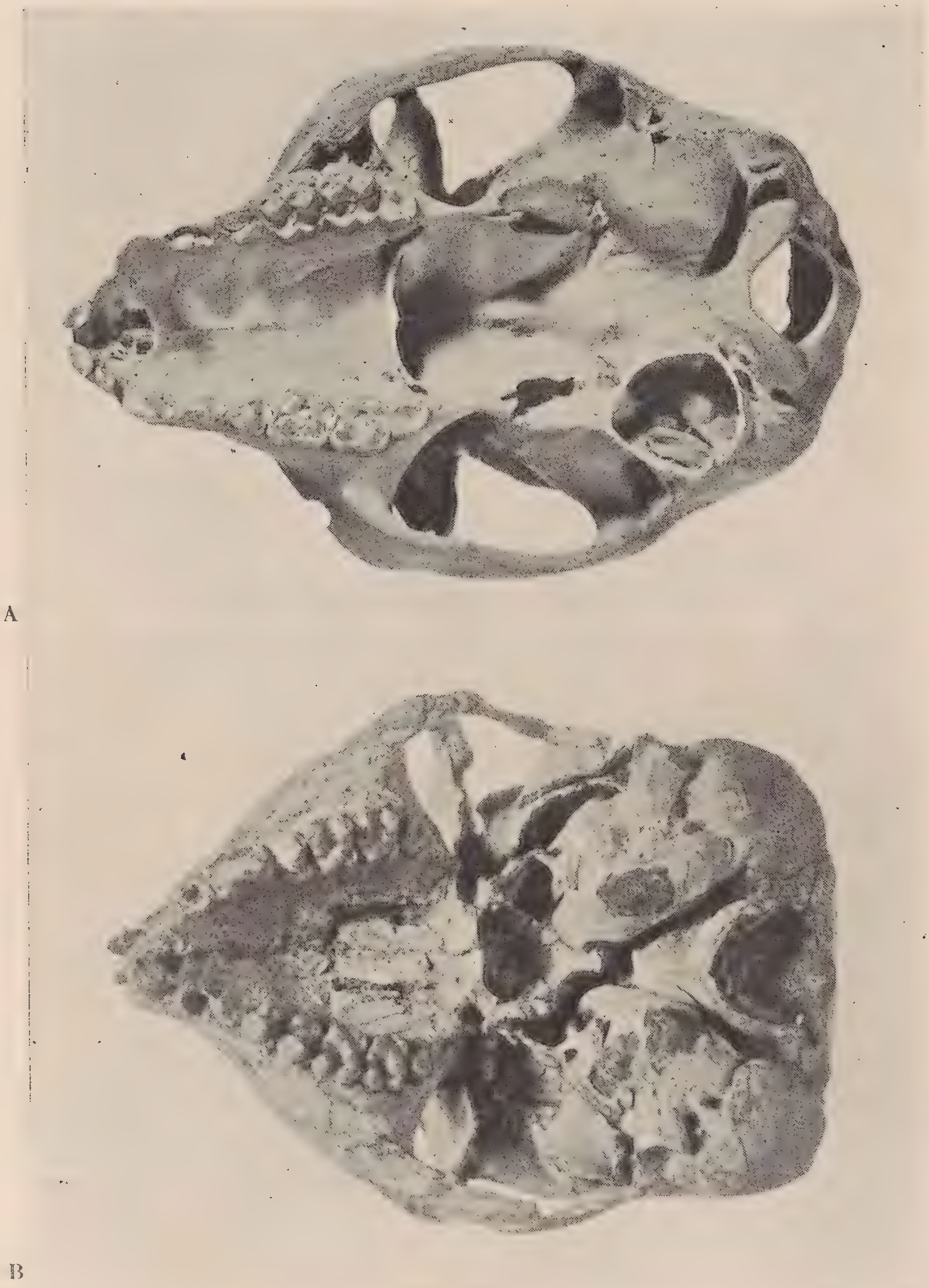

Fig. 3. Under side of the skull in two members of the suborder Lemuroidea, representing respectively the Lemuriformes (A) and the Tarsiiformes (B).

A. *Propithecus coquerelli.* Fam. Indrisidæ. Recent, Madagascar. $\times \frac{1}{1}$.

B. *Necrolemur antiquus.* Fam. Microchœridæ. Upper Eocene, France. $\times \frac{2}{1}$. This specimen was loaned by the Museum of Comparative Zoölogy at Cambridge, Mass. It has been freed from the matrix with great skill by Mr. A. E. Anderson.

In *Propithecus* the muzzle is wide, with enlarged canines, the palate is wide with parallel tooth rows. The zygomatic arches are stout; the wide posterior nares open behind m^2; the pterygoid alæ are elongate anteroposteriorly. The bullæ are of moderate size and completely enclose the small ring-like tympanic. The brain-case is of moderate width and the mastoid region not much swollen.

In *Necrolemur* the muzzle is narrow and pointed with small canines; the palate is narrow anteriorly with convergent tooth rows. The zygomatic arches are slender; the constricted posterior nares open far behind m_3 and the pterygoid alæ are much shortened. The bullæ are very large and expanded antero-internally and the large tympanic bone forms a tubular auditory meatus. The brain-case is very wide and the mastoid region much swollen.

Possibly the as yet undiscovered ancestral Catarrhinæ resembled *Necrolemur* in several of these characters, especially in the general appearance of the dentition, in the convergent tooth rows and in the swollen bullæ with tubular meatus.

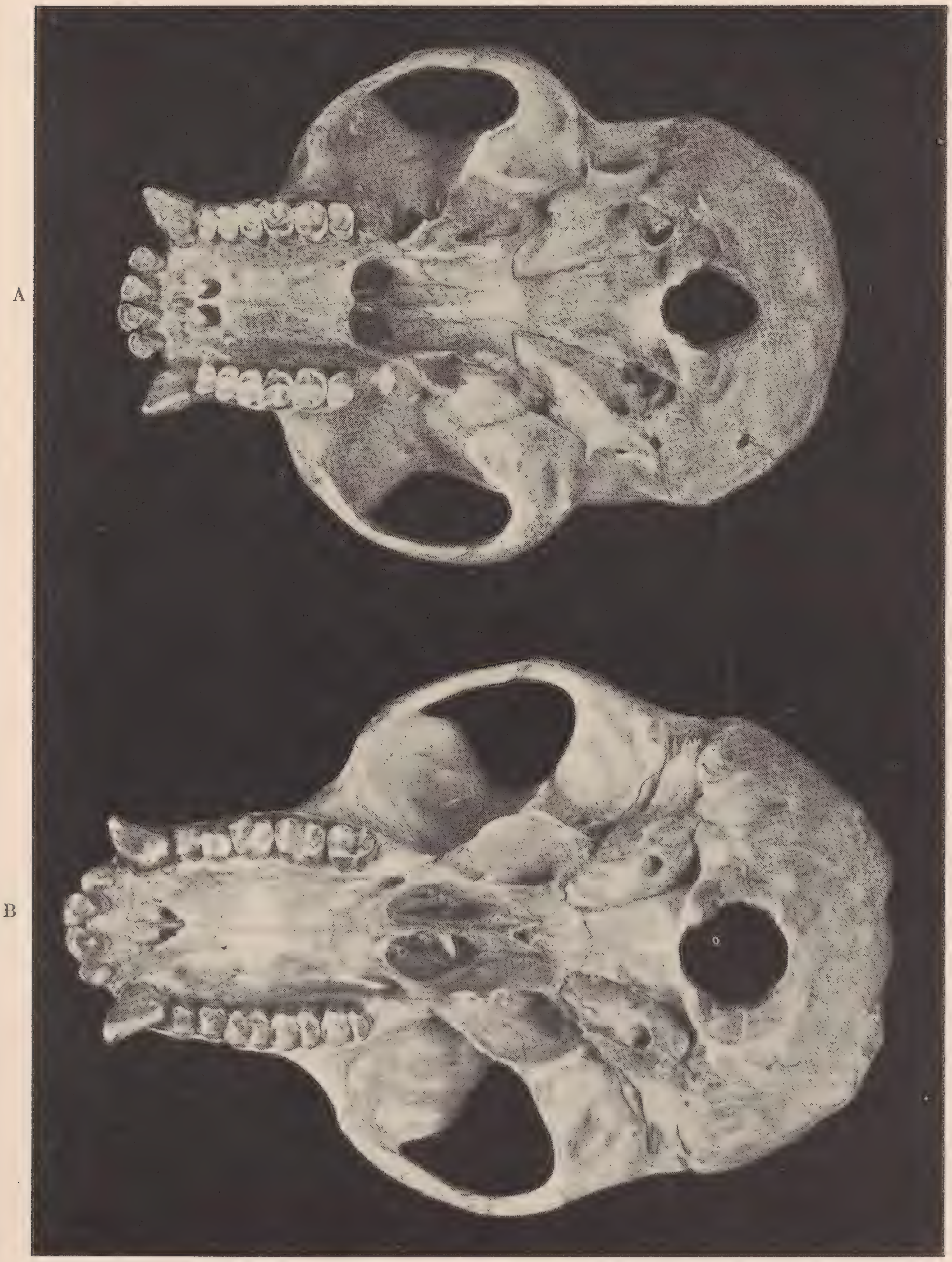

Fig. 4. Under side of the skull in two members of the suborder Anthropoidea, representing respectively the Platyrrhinæ (A) and the Catarrhinæ (B).

A. *Lagothrix lagotricha.* After Elliot.
B. *Nasalis larvatus.* After Elliot.

The Platyrrhinæ and the Catarrhinæ differ in so many important characters that they may have been derived from different families of Eocene lemuroids.

In the primitive Platyrrhinæ (A) the tooth rows and palate are relatively short, the three premolars are relatively large, the molars are small and rounded, retaining more or less of the tritubercular pattern. The posterior nares open near m^3. The whole base of the cranium is elongate; the hamular fossæ for the internal pterygoid muscles are small. The auditory bullæ are elongate obliquely and the tympanic bones form widely open swollen zones adherent to the bullæ. The internal carotid canal is frequently located on the posterior side of the periotic. The occiput is not very broad and is more or less rounded.

In the primitive Catarrhinæ (B) the tooth rows and palate are relatively long, the two premolars are small, the molars large and in the Cercopithecidæ are divided into anterior and posterior moieties each bearing a transverse crest. The posterior nares open behind m^3. The base of the cranium is short and wide; the hamular fossæ for the internal pterygoid muscles are large. The auditory bullæ are extended transversely and continuous with the elongate tubular tympanic. The internal carotid canal pierces the periotic on its posteroventral surface. The occiput is broad and more or less flat.

In brief I conclude that on the whole Doctor Wortman's suggested rearrangement of the Primates constitutes a radical and unnecessary departure from long accepted standards. Indeed I much prefer the following elegantly simple grouping of "Les Quadrumanes Normaux" which was proposed by DeBlainville in 1816.[1]

Singes du continent ancien
            Les Singes [Catarrhinæ]
  "   "   "   nouveau
            Les Sapajoux [Platyrrhinæ]
Makis
            Les Makis [Lemurs of Madagascar]
            Les Loris [Lorises and Galagos]
            L'Aye-Aye [Cheiromys]

In the present work, however, this grouping of DeBlainville's is hardly detailed enough for practical use and I therefore propose the following classification which I have gradually developed during the last few years:

Order Primates
  Suborder Lemuroidea [2]
    Series Lemuriformes
      Fam. Adapidæ
        Subfam. Notharctinæ (*Pelycodus, Notharctus, Telmalestes*)
          "   Adapinæ (*Pronycticebus, Protoadapis, Leptadapis, Adapis*)

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[1] Gregory, 1910. The Orders of Mammals, p. 77.

[2] The present classification of the Suborder Lemuroidea was first published, with definitions, in Nov. 1915. Bull. Geol. Soc. Amer., vol. 26, pp. 432–438.

Fam. Lemuridæ
Subfam. Lemurinæ
“ Chirogaleinæ
“ Megaladapinæ
Fam. Indrisidæ
Subfam. Indrisinæ
“ Archæolemurinæ (Nesopithecinæ)
Fam. Chiromyidæ (Daubentoniidæ)
Series Lorisiformes
Fam. Lorisidæ
Subfam. Lorisinæ
“ Galaginæ
Series Tarsiiformes
Fam. Microchœridæ [*Microchœrus, Necrolemur*]
“ Tarsiidæ [‘*Anaptomorphids*’ and *Tarsius*]
Suborder Anthropoidea
Series Platyrrhinæ (“narines éloignées,” DeBlainv. 1834)
Fam. Cebidæ
Subfam. Aotinæ (*Homunculus, “Nyctipithecus,” Callicebus*)
“ Alouattinæ (Mycetinæ, *Alouatta*)
“ Ateleinæ (*Lagothrix, Ateles, Brachyteles*)
“ Pithecinæ (*Pithecia, Cacajao*)
“ Cebinæ (*Cebus, “Chrysothrix”*)
Fam. Hapalidæ
Series Catarrhinæ (“narines rapprochées,” DeBl.)
Fam. Parapithecidæ (Schlosser) (*Parapithecus, Mœripithecus*)
“ Cercopithecidæ
Subfam. Oreopithecinæ
“ Cercopithecinæ
“ Semnopithecinæ
Fam. Simiidæ
Subfam. Hylobatinæ (*Propliopithecus, Pliopithecus, Griphopithecus, Hylobates, Symphalangus*)
“ Simiinæ (*Palæosimia, Simia, Sivapithecus, Dryopithecus, Neopithecus, “Anthropopithecus”* [*Pan*], *Gorilla*)

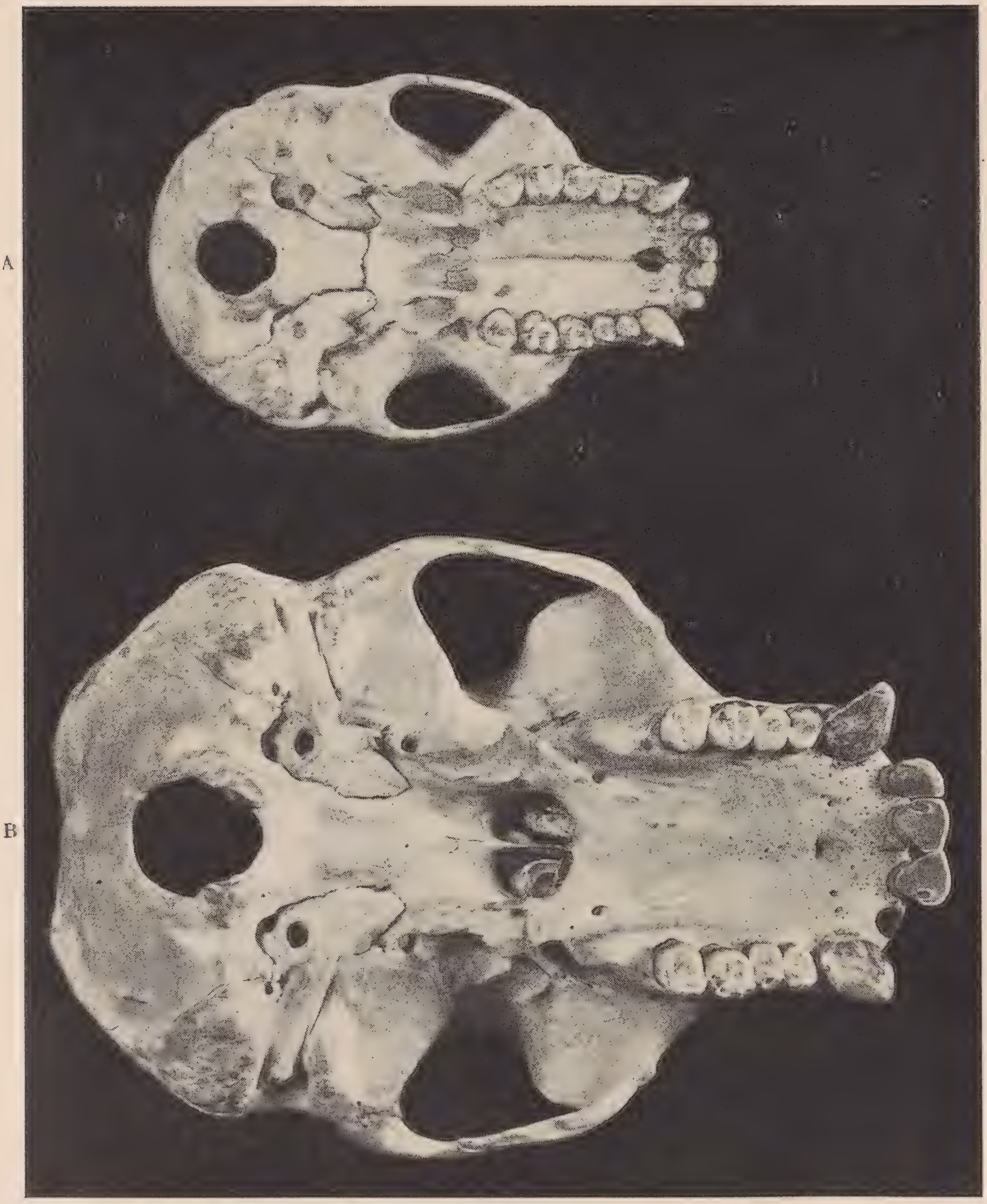

Fig. 5. Under side of the skull in (A) the gibbon (*Symphalangus syndactylus*) and (B) the chimpanzee (*Pan vellerosus*). After Elliot. (cf. Figs. 6–8).

Agreement in fundamental patterns is shown in the shape of the skull as a whole, in the number and form of the teeth (in this chimpanzee, however, the third upper molars have not erupted) and in the whole arrangement of the parts of the cranial base. The auditory region is identical in construction with that of the Cercopithecidæ (Fig. 4B).

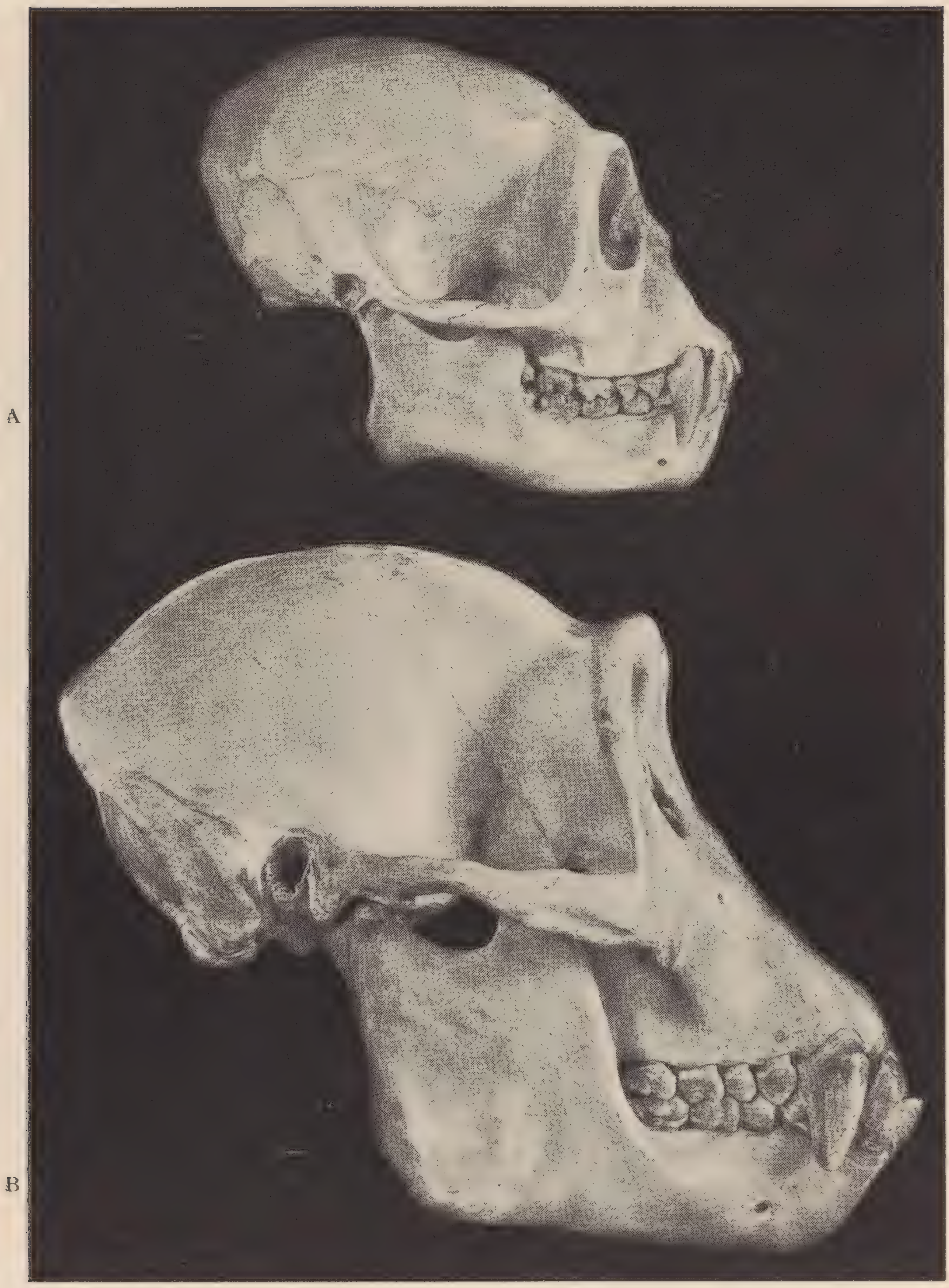

Fig. 6. Gibbon (A) and chimpanzee (B) skulls in side view (*cf.* Fig. 5). After Elliot.

Note the forward extension of the insertion areas of the temporal and masseter muscles. This gives to these muscles wide angles of insertion on the mandible with high crushing power for the molars and high piercing power for the erect pointed canines.

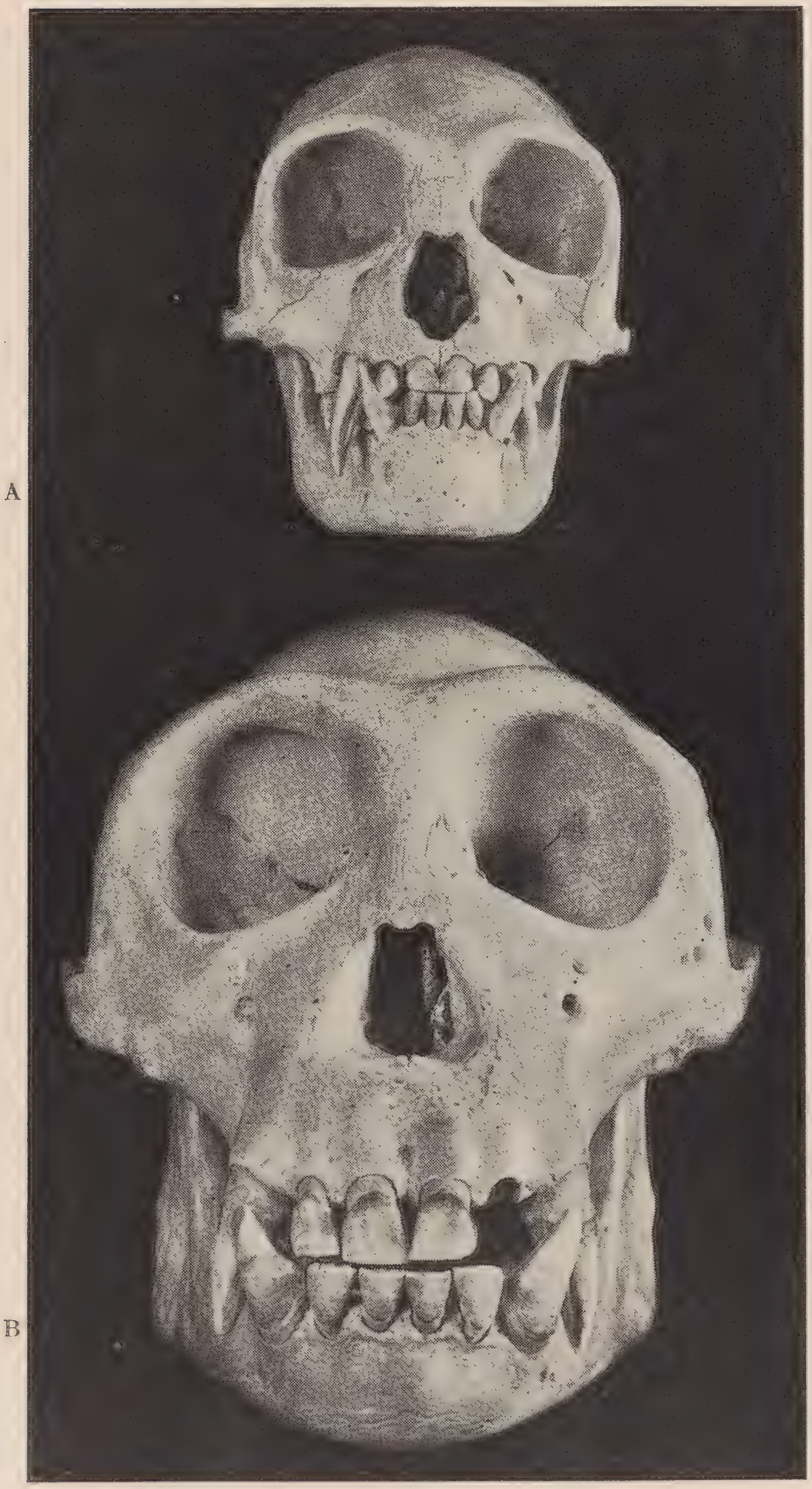

Fig. 7. Gibbon (A) and chimpanzee (B) skulls in front view.

A. *Symphalangus syndactylus.* After Elliot. × 1.

B. *Pan vellerosus.* After Elliot. × 1.

The opposite canines are widely separated, this bringing them near to the masseter muscles and increasing their piercing power. The axis of the lower canines is more or less parallel to the combined pull of the masseter and temporal muscles.

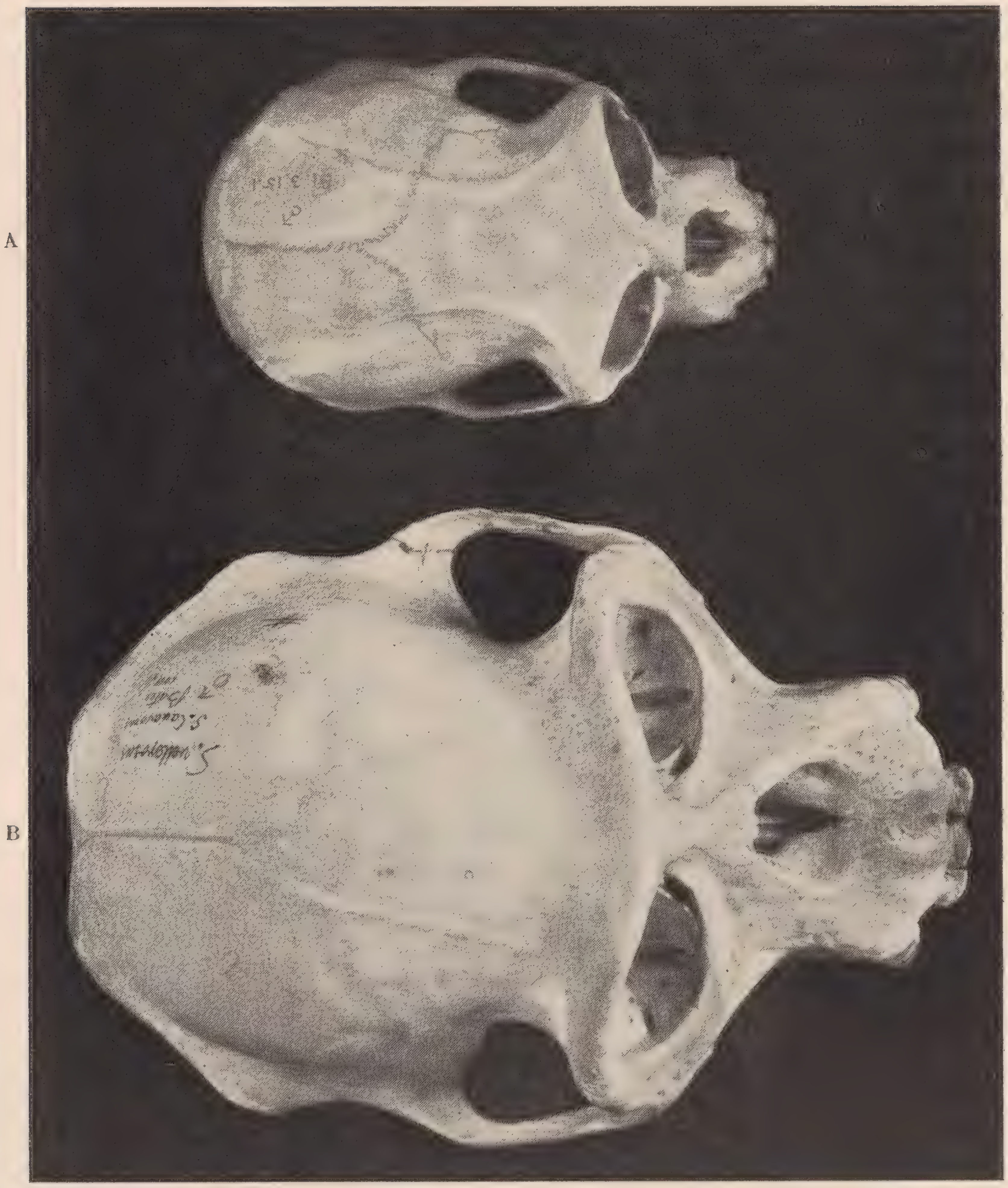

Fig. 8. Gibbon (A) and chimpanzee (B) skulls in top view (cf. Figs. 5, 6). After Elliot.

These top views illustrate the great width of the occiput and face in anthropoids, and the anteroposterior shortening of the whole skull.

The postorbital processes of the frontals and malars were originally developed in the lemuroid stage in connection with the forward extension of the temporal muscle, and served also as a brace for the base of the powerful masseter. In the higher anthropoids and early Hominidæ the postorbital rims become everted and extend dorsally, forming the supraorbital tori. Similar ridges are also developed in certain baboons. They serve to protect the eyes and the frontal part of the brain, and through the action of the overlying facial muscles (frontalis, orbicularis and pyramidalis nasi) they intensify the expression of anger or excitement.

II. CHIEF ADAPTIVE CHARACTERS OF THE SKULL, DENTITION AND LIMBS OF THE ANTHROPOIDS AND MAN.

The Gibbons.

(Figs. 5A, 6A, 7A, 8A).

Of the existing anthropoids the gibbons are on the whole the most primitive in skull and dentition. On the other hand, as compared with primitive Eocene lemurs (*Notharctus*, etc.), they share with other anthropoids and Old World monkeys the following characters:

the shortening of the face,
the narrowing of the olfactory region,
the forward growth of the orbits and frontals,
the progressive separation of the orbital and temporal fossæ,
the great widening of the brain-case,
the backward growth of the occipital portion of the brain-case,
the beginning of the downward deflection of the facial part of the skull.

In their incipient stages all these characters were doubtless characteristic of the ancestral catarrhine Primates as a whole and are to be regarded as primarily specializations for arboreal existence; they are correlated in part with a progressive enlargement of the cerebrum and a reduction of the olfactory portions of the brain. At the same time they foreshadow the end specializations of higher types.

The bony posterior walls of the orbit separate the eye and its muscles from the powerful temporal muscles, which are inserted on the posterior rim of the protruding orbits as well as on the sides of the brain-case. This voluminous anterior extension of the temporal insertion-area, together with the forward pushing of the brain-case, has no doubt conditioned in part the forward growth of the orbits, the shutting-off of the orbits from the temporal fossæ, and the retraction of the face. There is no sagittal crest, the opposite insertion-areas of the temporal muscles being widely separated by the flattened parietal vertex.

The jaws and dentition of the gibbons, as in all other anthropoids, are adapted chiefly for a frugivorous diet. The gibbons are more primitive than the other anthropoids in retaining the sub-tritubercular upper molars, in which the primitive trigonal pattern of the crown is only a little modified by the upgrowth of the postero-internal cusp, or hypocone, the inner side of the crown still being narrow and supported by an undivided root. All the molars lack the folds and wrinklings that are seen in the higher anthropoids. The lower molars have the four main cusps and the postero-median cusp, or hypoconulid, which are characteristic of the anthropoids and man. The middle part of the crown as in all Primates forms a broad basin for the reception of the main internal cusps (protocone) of the upper molars. The small premolars, or bicuspids, which, as in other catarrhines, are reduced to two above and below on each side, testify to the former loss of the two anterior premolars of the primitive placental dentition and to the marked shortening of the face in the remote ancestors of the gibbons. The very large saber-like canines may be either a defensive specialization or, more probably, a frugivorous one. The assumption of the tusk-like form has evidently conditioned the deepening of the anterior part of the lower jaw, the firm union of its opposite halves, and the rapid upward slope of its posterior border. The slenderness of the horizontal ramus is in all probability a retrogressive character: first, because in all other anthropoids the ramus is deep; secondly, because there is wide variation in this character in the genus *Siamanga* (see Bolk 1915); and thirdly, because an analogous reduction of the ramus is seen in the Cebidæ in several genera.

The incisors of the gibbons have remained rather primitive in form and consist of small procumbent chisel-like teeth, well adapted for holding and cutting fruits, the inner pair being only slightly enlarged and not excessively wide as in higher anthropoids.

Certain skull characters are undoubtedly connected with the upright pose of the gibbons, both in sitting and progressing, especially the downward facing of the foramen magnum, which brings the head at a sharp angle to the vertebral column.

The upright pose may have originated in connection with a change in the mode of locomotion. The primitive lemurs of the Eocene climbed, ran and jumped more upon the tops of the branches; the gibbons in progressing swing beneath the branches, the arms being held above the head. This acrobatic mode of locomotion, which has been appropriately called "brachiation" by Professor Keith, very probably took rise in the earliest anthropoids and has been carried to an extreme specialization in the excessively long armed gibbon.

Thus the habit of sitting upright, which first set free the hands for prehensile purposes and improved the power of supination, very probably preceded the habit of brachiation and the loss of the tail, as it has also in the genus *Indris* among the lemurs. The gibbons retain traces of the ischial callosities, which are fully developed in the lower Catarrhinæ but are lost in the higher anthropoids and man.

The Orang-utan.

The head of the orang-utan is distinguished by its marked shortness, roundness and great vertical diameter. The orbits are brought very close together, this reducing the entire nasal and orbital regions to an extreme narrowness. The orbits are very deep, the face is flat transversely and concave in the side view. The orbit is almost completely shut off from the true temporal fossæ. The brain-case is, so to speak, pushed forward over the face so that the basifacial axis is sharply inclined to the basicranial axis. Old males exhibit a sagittal crest, but possibly this is a secondary crest, produced by the upgrowth of the insertion-areas of the temple muscles, and it may not be homologous with the primitive sagittal crest seen in other orders of mammals.

As in all other anthropoids the massive teeth, jaws, and jaw-muscles are specialized for a frugivorous diet, the orang being able to tear open the tough rind of the fruit of the durian. The upper molar teeth are fully quadritubercular with four-sided rather than triangular crowns. The surface of the crowns is low and flat with very numerous fine wrinklings on the enamel — an advanced specialization. The protocones or anterior internal cusps are only faintly connected with the external cusps, the para- and metacones. The premolars are relatively stouter than in the gibbon. The stout canines are highly effective in opening fruit and in fighting. The central upper incisors are very broad with flattened posterior faces. The long-crowned incisors and canines, as seen from below, form an evenly rounded or arched series.

The massive deep lower jaw has a wide distal end and a broad, high, ascending ramus; the condyle is raised above the level of the coronoid, in correlation with the forward displacement of the brain-case and the downward and backward displacement of the muzzle. The lower anterior premolar is stout and less elongate than in the gibbon, but more elongate than in the chimpanzee. Its oblique antero-external slope is worn, as in other anthropoids, by the postero-internal face of the upper canine. The posterior lower premolar is approaching the molar pattern, especially in its posterior moiety. The lower molars have five cusps as in other anthropoids, but the crowns are flatter and much wrinkled. The opposite premolar-molar series diverge slightly in front, in correlation with the widening of the muzzle and the wide separation of the opposite canines at this point.

The fore limbs of the orang are less extremely elongate than those of the gibbon, but are more elongate than those of the chimpanzee. This excessive length of the arms and hands is not to be expected in the primitive anthropoid stock.

In keeping with its gigantic size the adult orang, although a master acrobat, is less agile than the gibbon and shows many structural adaptations that are connected with a massive thorax and abdomen.

The Chimpanzee.

(Figs. 5B, 6B, 7B, 8B).

The head of the chimpanzee is considerably longer than that of the orang; the most prominent feature in the top view is the extreme protuberance of the orbits and the outgrowth of bony ridges between, above and outside of the orbits. As in the gibbon all these outgrowths are connected with the forward extension and increase of the insertion-areas of the temporal and masseter muscles. The protrusion of the orbits and the development of orbital ridges may be regarded as part of the specialization for frugivorous diet, along with the deepening of the jaws. The sagittal crest of the males is apparently secondary.

The upper molars clearly retain the sharp V-like ridges of the primitive tritubercular pattern, but they add thereto a poorly developed posterior ridge running from the enlarged hypocone to the metacone. There is a decided tendency to divide the internal root into an anterior and posterior moiety, or rather, the formerly distinct roots may be in course of coalescing. The lower molars exhibit the four main cusps and the postero-median cusps which are characteristic of the great apes and man, and in the pattern of their crowns they distantly approach the human type although the antero-posterior diameter is still greater and the posterior moiety of the crowns not expanded. Traces of the primitive cross-ridges (protolophid, metalophid) are retained. The third upper and lower molars are somewhat reduced in size and degenerate in form. The rounded contour of the upper molars is correlated with the partly oblique, partly rotary excursion of the mandible. The molar crowns are coarsely wrinkled, the cusps being lower than in the gorilla. The upper premolars are comparatively small and are prominently bicuspid. The lower premolars are of normal anthropoid type, but are under the average size. The opposite premolar-molar rows are nearly parallel in the lower jaw but diverge in the upper jaw of old males. The canines form stout tusks. The anterior upper incisors are extremely wide with large wrinkled crowns. The muzzle as a whole is massive.

The Gorilla.

The gorilla carries to the logical extreme the frugivorous and fighting specializations which are foreshadowed in the chimpanzee. The head is lengthened by the forward growth of the muzzle and by the extreme backward growth of the skull-top. Thus the gorilla skull, to a certain extent, parallels that of the baboons. The supraorbital protrusion is now extreme. The secondary sagittal crest and widely flaring occipital crests attain an excessive development in old males, and are conditioned by the massive size of the muscles of the jaws and neck.

The canines form great tusks and hence the muzzle and lower jaw are very wide in front and the opposite premolar-molar series diverge anteriorly. The palate and basis cranii also reflect these swine-like adaptations. All these specializations are either absent or feebly developed in the females and young and may be looked upon as comparatively recent acquisitions which disguise the underlying similarity to the chimpanzee skull. The incisors are relatively narrow. The upper premolars are wide; the front lower premolar, in correlation with the tusk-like form of the upper canine, is shaped somewhat like that of a baboon, with a sloping well worn antero-external face. The molars all have conical cusps which are higher than in the other anthropoids and are less complicated by secondary folds and wrinkles. In correlation with the marked anteroposterior elongation of the head the upper molars are now divided into large anterior and smaller posterior moieties, but clear traces of the original trigonal pattern remain (Fig. 20B^1, B^2). The lower molars (Fig. 27A) are also more elongate than those of the chimpanzee. The protoconid and metaconid are connected by a cross crest (protolophid) which fits between two adjacent upper molars (Part I, Fig. 11B). The fundamental pattern of all the premolars and molars are those seen in all anthropoids. The lower jaw is very massive with a long stout horizontal ramus and broad ascending ramus.

Thus the fundamental resemblances to the human skull are largely disguised in the male gorilla, which is distinguished by the great tusks and massive cheek teeth, the divergent tooth rows, the baboon-like muzzle and protruding orbits, in contrast with the opposite specializations in man. The young female gorilla on the other hand, except in the dentition, more distinctly approaches the human type than any other anthropoid, in all views of the skull (profile, front, top and back), in the interior and base of the brain-case and in the details of the tympano-petrosal region.

The limbs and body of the gorilla exhibit marked adaptations to its gigantic and clumsy stature. It has departed from the primitive slender-limbed and arboreal type and exhibits a more or less transitional stage leading to bipedal ground-dwelling habits. As in the ground-sloths the long arms, stout, short legs and widely expanded pelvis are adapted for the support of the enormous thorax and abdomen.

The hands of the gorilla are more human than those of any other anthropoid, although the thumb is relatively smaller than in man and has not acquired the power of fully opposing itself to the other digits. So also the pes of the gorilla distinctly approaches the human type in the development of the heel, in the long metatarsals and short phalanges and in the diminution in volume of the digits from I to V. In the gorilla, however, the hallux is still of the old grasping type which is characteristic of all Primates except man (Fig. 31). Professor Keith has shown that this grasping type of pes assists the anthropoids in attaining a fully erect posture and balance while in the trees, but it is rather a hindrance to the upright position on the ground. (The structure of the gorilla foot is further discussed below, p. 330, 332.)

Man.

The anthropoids are chiefly frugivorous and typically arboreal; when upon the ground they run poorly and (except in the case of the gibbons) use the fore limbs in progressing. Thus they are confined to forested regions. Man, on the other hand, is omnivorous, entirely terrestrial, erect, bipedal and cursorial, an inhabitant primarily of open country. The anthropoids use their powerful canine tusks and more or less procumbent incisors for tearing open the tough rinds of large fruits and for fighting. Primitive man on the contrary uses his small canines and more erect incisors partly for tearing off the flesh of animals, which he has killed in the chase with weapons made and thrown or wielded by human hands. These implements and weapons also usually make it unnecessary for man to use his teeth in fighting and functionally they compensate for the reduced and more or less defective development of his dentition.

The comparative anatomical evidence alone is, I believe, sufficient to establish that in spite of these wide differences in habitus man is closely akin to the chimpanzee-gorilla group. All competent authorities will agree with MM. Boule and Anthony and Professor Keith that man bears an indelible stamp of remote arboreal ancestry, that upright or semi-upright progression in the trees was a prelude to the profound changes initiated by the assumption of bipedal progression upon the ground. The change from arboreal to terrestrial life must have been correlated with a great change in food habits from a chiefly frugivorous to an omnivorous diet.

In all known anthropoids, both recent and extinct, the powerful jaws and teeth seem to be adapted for tearing open the tough rinds of larger fruits, while early man, on the other hand, was a great hunter and flesh eater, like most primitive tribes of the present day. And every observer knows what efficient structures the incisors and canines of savages are in tearing off pieces of flesh.

Hence all the non-anthropoid and distinctively human features in the dentition of man seem to be relatively late specializations, which constitute a functionally correlated series. This complexly interrelated series of more or less simultaneous changes included the following elements (Fig. 9A):

(1) Shortening of the muzzle and symphysis.

(2) Retraction of all the anterior teeth, the incisors becoming more erect, the canines decreasing in size and the "edge-to-edge bite" becoming further emphasized.

(3) Reduction in size of the front lower premolar and the completion of its bicusped character (Fig. 27E, F, G).

(4) Development of a chin (a late feature).

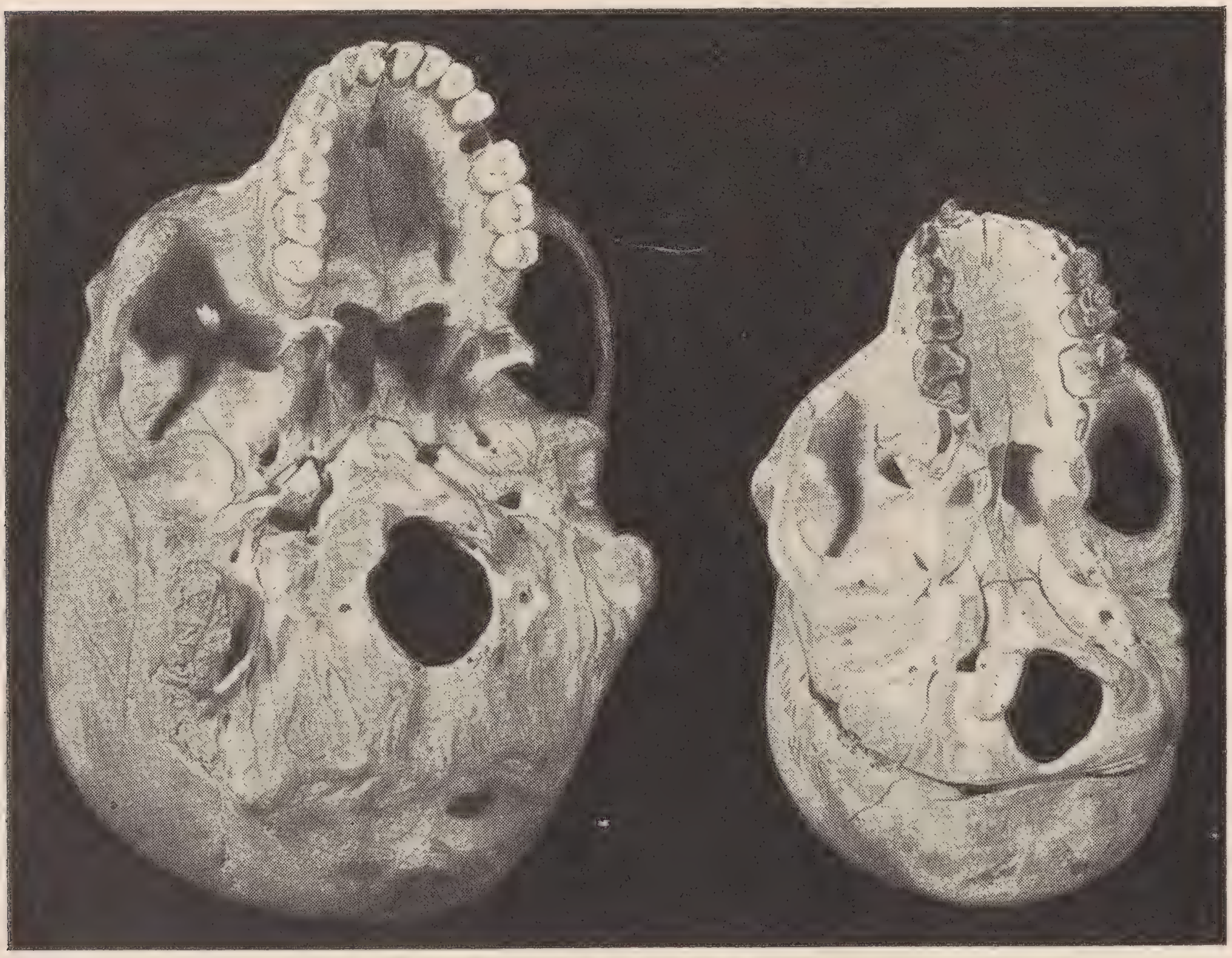

Fig. 9. Under side of the skull in a female Australian black (A) and in a young gorilla (B).

The agreement in the underlying structure of the brain-case is masked by the wide differences in the dentition and in the upper jaw and its related parts.

The structure of the auditory region is fundamentally the same, but in man the carotid canal is larger and the tympanic spout develops an inferior crest.

(5) Increasing convergence of the opposite tooth rows and widening of the intercondylar diameter of the mandible.

(6) Rounding of the molar crowns, progressive obliteration of the anthropoid, or *Dryopithecus*, pattern (*postea*, p. 293) of the molars and in some cases progressive loss of the hypoconulid on the second and third lower molars. Progressive reduction of the third upper molar from a more quadrilateral to a more tritubercular pattern.

(7) A change in the predominant movement of the mandible from a more ruminant-like, obliquely transverse movement, to movements in all directions and of a partly rotary character. (Especially correlated with the reduction of the canines.)

(8) A long and complexly interrelated series of changes connected with the assumption of the upright posture, the enormous increase in the brain-case and the consequent balancing of the head upon the neck. This influenced the dentition, especially by changing the insertion areas of the jaw muscles (*cf.* Miller, 1915) and perhaps permitted retrogressive changes, due to the diminished functional importance of teeth as compared with brains.

(9) A final shifting and readjustment of the whole lower dental arch in such a manner that the upper incisors finally overhung the lower incisors, and that each lower molar, which formerly articulated with two upper molars, came to articulate chiefly with only one upper molar (Part I, Fig. 11).

In brief, the skull and dentition of man in comparison with those of all anthropoids exhibit the following adaptive characters:

enormous expansion and deepening of the brain-case;

extreme shortening of the face;

retraction of the front part of the lower dental arch;

reduction in size of the dentition;

tooth row forming a more or less rounded arch;

canines not protruding much above the level of the other teeth;

anterior premolars transversely widened and fully bicuspid rather than compressed in form;

fusion of the premaxillaries with the maxillaries;

lower jaw with progressively protruding chin, early losing the inferior symphyseal ledge;

reduction of the supraorbital crest;

extreme retraction of jaws beneath brain-case;

articular eminence for the lower jaw small and strongly convex, permitting motion in all directions;

glenoid fossa very deep;

zygomatic arch feeble;

mastoid processes large and prominent;

tympanic plate (which is elongate and spout-like in the lower anthropoids) abbreviated;

carotid canal (which pierces the petrosal) much enlarged.

The limbs and backbone abound in well-known adaptations to erect bipedal terrestrial locomotion, some of which are discussed below (p. 327–336).

III. THE FAYÛM OLIGOCENE ANTHROPOIDS.

Parapithecus *Schlosser.*

(Figs. 10A, 11A, 17A).

The anthropoids of the Lower Oligocene of Egypt, which have been carefully figured and described by Schlosser (1911), are of capital importance in the history of the higher Primates. Of these the genus *Parapithecus*, known from a well preserved lower jaw with complete dentition, is, as noted by Schlosser, by far the most primitive of all known Old World monkeys and apes. The animal was of very small size, not bigger than a squirrel monkey. Its dentition and jaw appear to be adapted not for eating large fruits with heavy rind as in the typical anthropoids but small fruits and perhaps insects.

The opposite rami of the lower jaw converged rapidly toward the narrow chin, which sloped sharply backward. The two incisors (on each side) were narrow and gently procumbent. The canine was small and not tusk-like, its tip no higher than that of the incisors and premolars, its crown low, conic with an incipient posterior basal cusp and a well marked internal cingulum. The two premolars were incipiently bicuspid, each with a large external cusp, a low postero-internal cusp and a low posterior cingulum. The first two molars have low crowns with the five cusps normal in the anthropoid-man series (protoconid, metaconid, hypoconid, entoconid, hypoconulid, or mesoconid), the paraconid being absent; the trigonid basin small, the talonid, or posterior moiety of the crown, large. The four principal cusps are arranged in transverse pairs the metaconid internal and slightly posterior to the protoconid, and connected with it by a low ridge, the protolophid; the entoconid slightly posterior to the hypoconid, the latter enlarged; all cusps very low, rounded, not wrinkled; an external cingulum; hypoconulid median; molars narrow; third molar with narrow posterior moiety. Mandibular ramus fairly stout but not deep, coronoid process high, recumbent, extending much above condyle, the latter widened transversely. These characters imply that the skull was of much lower grade than that of the typical anthropoids.

The dental formula as provisionally given by Schlosser namely $I_{\overline{1}}$, $C_{\overline{2}}$, $P_{\overline{3}}$, $M_{\overline{3}}$, should, perhaps, be changed to $I_{\overline{2}}$, $C_{\overline{1}}$, $P_{\overline{2}}$, $M_{\overline{3}}$, for the following reasons:

(1) the second tooth of the series looks to me more like $I_{\overline{2}}$ of *Pliopithecus;* its crown is likewise separated by a small cleft from the tooth which I identify as the lower canine;

(2) a comparison of the premolars of *Parapithecus* with those of *Propliopithecus* and *Pliopithecus* indicates that we have here *two* premolars not *three* as suggested by Schlosser; these premolars are more primitive or less bicuspid than in later types;

(3) the tooth which I call the canine and which Schlosser calls the first premolar is more caniniform than the anterior premolars and is comparable with the canine of *Propliopithecus;*

(4) This interpretation brings *Parapithecus* into harmony with its nearest allies and with all other catarrhines, with which it agrees also in the fundamental pattern of the premolars and molars.

The reduction of the dental formula in *Parapithecus* and all other Old World Primates from the primitive Eutherian formula of 3. 1. 4. 3 to $I\frac{2}{2}$, $C\frac{1}{1}$, $P\frac{2}{2}$, $M\frac{3}{3}$, offers good evidence that at a very early period the muzzle and jaws in the Old World Primates were shortened to such a degree that one incisor, and two anterior premolars, on each side, above and below, had been crowded out, as in the Eocene *Anaptomorphus æmulus.* Such crowding and elimination may still be traced in the Lemuroidea, since the oldest family, the Adapidæ, retain the formula $I\frac{2}{2}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$, while the most specialized genera of the Indrisinæ reduce the formula to $I\frac{2}{1}$, $C\frac{1}{1}$, $P\frac{2}{2}$, $M\frac{3}{3}$.

Accordingly *Parapithecus* appears to stand as structurally ancestral to the whole anthropoid-man series, and as derived in turn from Eocene, insectivorous lemuroids. Dr. Schlosser has suggested that *Parapithecus* is related to the Eocene Anaptomorphidæ and such relationship may eventually be demonstrated. The molars and premolars do indeed suggest derivation from a far more primitive insectivorous type, represented in *Omomys* sp. as figured by Matthew (1915, p. 449), but in this otherwise very primitive member of the Anaptomorphidæ the incisors are apparently not fitted to give rise to those of *Parapithecus. Anaptomorphus æmulus,* as above noted, has the right dental formula, $\frac{}{2 \cdot 1 \cdot 2 \cdot 3}$ (Matthew, 1915, p. 457), but in the absence of intermediate types it would be rash to regard it as ancestral to *Parapithecus. Tetonius* ("*Anaptomorphus*") *homunculus* is aberrantly specialized in many characters and the same is true of all other known genera of the Anaptomorphidæ, which as a family appear to be allied with *Tarsius* rather than with the catarrhine series.

The lower jaw and teeth of one of the South American monkeys (*Chryso-*

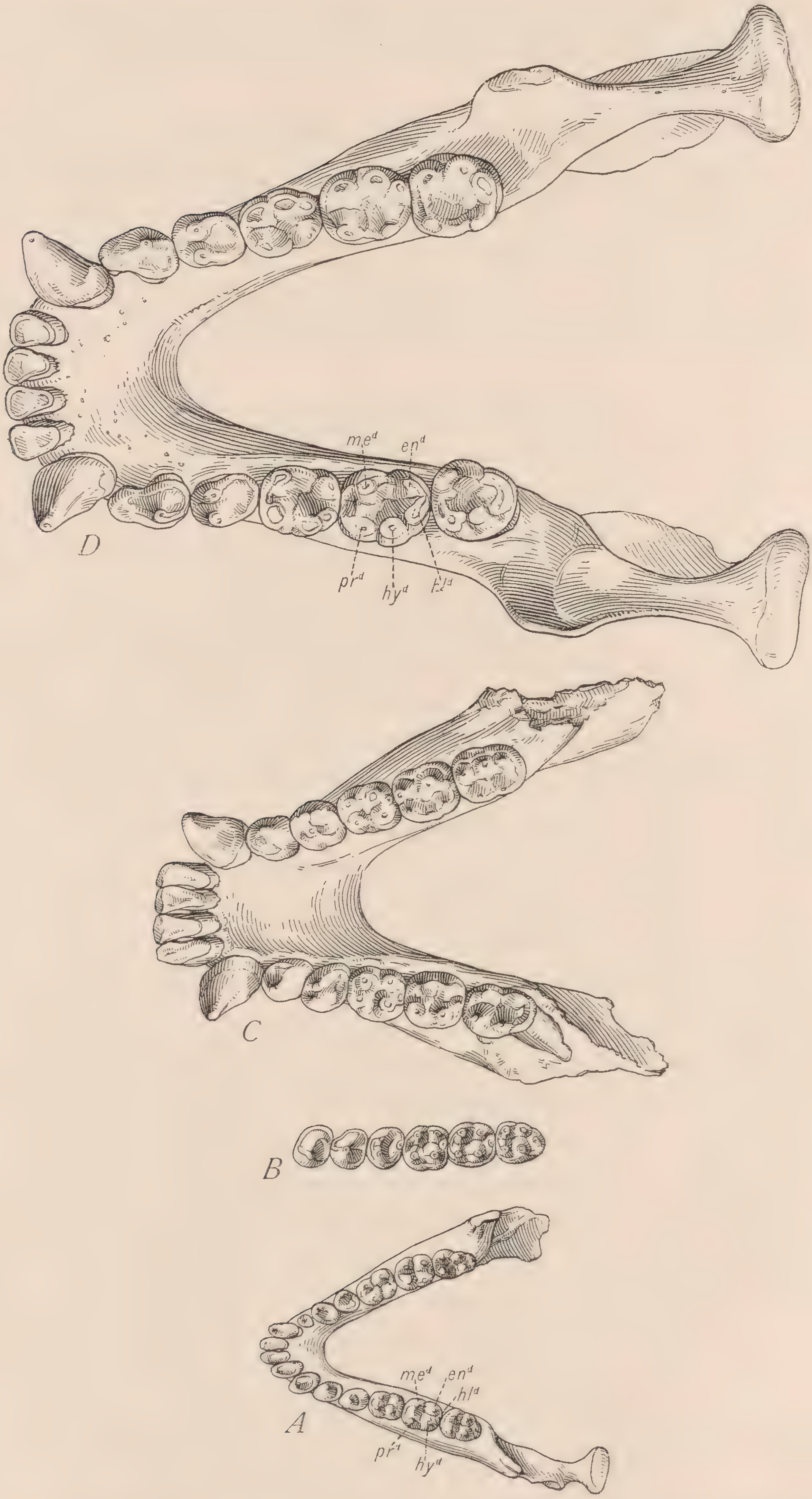

Fig. 10. Lower jaws and teeth of Parapithecidæ and Hylobatinæ. Dorsal view. Natural size.

A. *Parapithecus fraasi.* Lower Oligocene, Fayûm, Egypt. After Schlosser.
B. *Propliopithecus haeckeli.* Lower Oligocene, Fayûm, Egypt. After Schlosser.
C. *Pliopithecus antiquus.* Lower Pliocene, Germany. After DeBlainville, modified from a cast of the same specimen.
D. *Hylobates* (*Symphalangus*) *syndactylus.* Recent, Asia. After DeBlainville, modified from specimens.

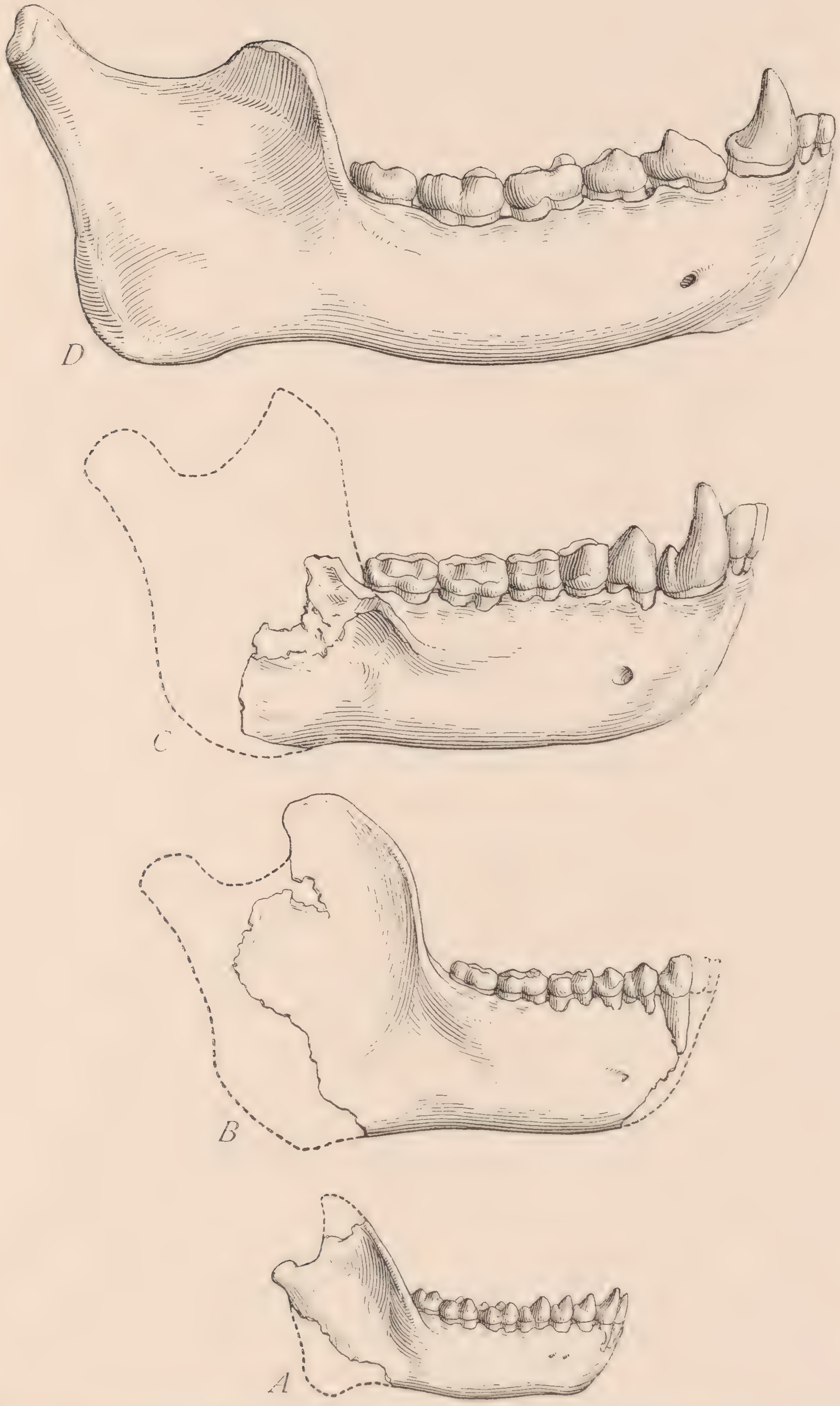

Fig. 11. Lower jaws of Parapithecidæ and Hylobatinæ. Side views. Natural size. For explanations see fig. 10.
In Figs. A, B, C, the missing parts are restored hypothetically by the author.

thrix) as noted by Schlosser resemble those of *Parapithecus* in several characters. But all the Platyrrhinæ retain three lower premolars, and may rather represent a parallel series also derived from Eocene Lemuroids.

In conclusion, unquestionably the jaw of *Parapithecus* is structurally intermediate between a lower insectivorous anaptomorphoid stage and a higher anthropoid stage.

Propliopithecus *Schlosser.*

(Figs, 10B, 11B, 17B).

This genus, so far as known from the lower jaw, is justly regarded by Schlosser as structurally ancestral to *Pliopithecus* and the higher anthropoids, and the characters about to be mentioned appear to be primitive for the man-anthropoid series. Although larger than *Parapithecus* the genus under consideration was much smaller even than a modern gibbon.

The jaw and dentition appear to be adapted for eating fruits with fairly heavy rinds. Unfortunately the incisors are not preserved but may well have approached those of *Pliopithecus.* The canine in side view has a low crown, rounded at the tip and sub-premolariform. In section it is roundly oval. It has a strong internal basal cingulum and a low internal basal cusp. Its fang is very stout and vertical. The anterior lower premolar (p_3) has a large single external cusp, a low internal cingulum and a very small postero-median cusp. The posterior premolar (p_4) has a truly bicuspid anterior moiety with a small trigonid basin, or anterior valley, and a very low talonid basin with a postero-median cusp. The first molar consists of four main cusps arranged in pairs and of a single postero-median cusp, or hypoconulid. The paraconid is wanting and the metaconid is connected by a faint transverse crest with the base of the protocone. The hypoconid is the largest cusp, with a large antero-internal slope. It is connected by a very faint crest with the protoconid, this crest apparently foreshadowing the "crista obliqua" of later types. As in all anthropoids the depressed middle of the crown forms a basin for the reception of the massive protocone of the superior molar. The furrows formed by the intersection of the bases of the cusps make a pattern that foreshadows the "*Dryopithecus* pattern" described below. The large hypoconulid, or postero-median cusp on m^1 lies nearer to the entoconid than to the hypoconid. There is a well marked external cingulum. The posterior moiety of the third lower molar is narrow. The horizontal ramus, or body, of the mandible is deep and the ascending ramus very broad, the coronoid process high and wide. The chin may well have been fuller (less sloping) than in *Parapithecus.*

From these characters we may infer with confidence that the upper dentition and skull had the following characters: (1) upper canine not greatly enlarged. (If it had been the anterior lower premolar would have been enlarged and compressed and the lower canine would have been tusk-like.) (2) Upper premolars more or less bicuspid. (3) Upper molars quadritubercular, with wide protocone and low hypocone, but retaining clear traces of an earlier trigonal pattern. (4) Skull more or less like that of a small gibbon but with much shorter, more massive jaw, and presumably stouter malars. As to the affinities of *Propliopithecus* with the later types Dr. Schlosser held that it was not only directly ancestral to the *Pliopithecus*-Gibbon line but also to all the higher anthropoids and man — a view which appears to the present writer to be in accord with present evidence (*postea*, pp. 294, 303, 304).

It may be objected that *Propliopithecus* should be regarded rather as a collateral ancestor of these later types than as a direct ancestor, and it may be argued that there may have been other genera of anthropoids living at that time in Egypt or elsewhere, which were the true and direct ancestors of the later types. But before postulating the existence of such genera a critic may well be required to show what characters of the already known genus definitely exclude it from such ancestry. In the reviewer's judgment the characters cited by Dr. Pilgrim (1915) for this purpose are wholly insufficient and are indeed primitive anthropoid characters.

IV. THE SIWALIK UPPER MIOCENE AND LOWER PLIOCENE ANTHROPOIDS.

As described by Lydekker[1] in 1886, the fossil Primates of India included extinct species of macaques, baboons and semnopitheques, and two anthropoid apes apparently related respectively to the orang and the chimpanzee. This composite assemblage of genera now widely separated in Africa and Asia tended to confirm the faunal kinship of these continents with each other and with Europe during the later Tertiary and inspired the hope that eventually the Siwaliks series would yield important evidence on the origin and interrelationships of the great apes and man.

In recent years the Geological Survey of India has secured more of these fragmentary but very important fossils, which have lately been accurately described and figured by Dr. Guy E. Pilgrim in a memoir entitled "New Siwaliks Primates and their bearing on the question of the Evolution of Man and the Anthropoidea."[2]

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[1] Indian Tertiary and Post-Tertiary Vertebrata. Siwalik Mammalia Supplement I. Mem. Geol. Surv. Ind., Ser. X, Vol. IV, Part I.

[2] Records of the Geological Survey of India, Vol. 45, Pt. 1, Febr. 1915.

According to Pilgrim the Primates of India appear first in the Chinji zone (Lower Siwaliks) which is regarded as of Lower Sarmatian (Upper Miocene) age; they extend through the Nagri and Dhok Pathan zones (Middle Siwaliks) of Pontian or Lower Pliocene age, and culminate in the upper zones of the Upper Siwaliks, of Upper Pliocene age (Fig. 37).

All belong exclusively to the Catarrhine or Old World division of the suborder Anthropoidea. More in detail the Lower Siwalik series (Chinji zone, Upper Miocene) includes: (a) two species of *Dryopithecus,* a primitive genus of the great apes, hitherto known only in the Upper Miocene and Lower Pliocene of Europe; (b) *Palæosimia,* a supposed ancestor of the orang, and (c) *Sivapithecus,* a genus regarded by Pilgrim as related to the ancestors of the Hominidæ.

The Lower Middle Siwalik series (Nagri zone, ?Upper Miocene) includes a gigantic species of *Dryopithecus* (*D. giganteus*). The Upper Middle Siwalik series (Dhok Pathan zone, Lower Pliocene) includes *Palæopithecus,* an anthropoid which was regarded by Lydekker as closely related to the gorilla and chimpanzee.

The Upper Siwaliks (Upper Pliocene) include an orang and several species of macaques, baboons and semnopitheques.

Through the kindness of Dr. Pilgrim the American Museum of Natural History has secured casts of the principal types of Siwalik anthropoids and these, together with the extremely accurate figures given in Dr. Pilgrim's memoir, have enabled the reviewer to make careful comparisons with other recent and fossil anthropoids.

Palæosimia rugosidens *Pilgrim.*

(Fig. 12A).

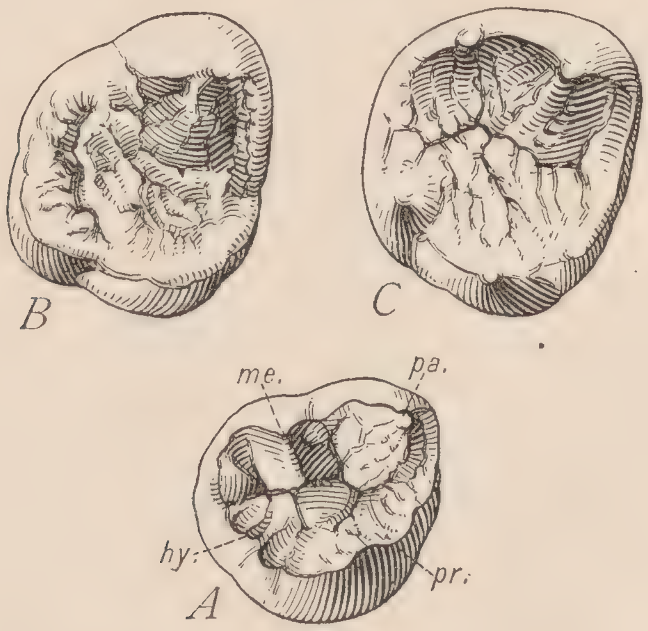

Fig. 12. Comparison of the third right upper molar of *Palæosimia rugosidens* Pilgrim with those of two modern Orang-utans. × $\frac{3}{2}$.

A. *Palæosimia rugosidens.* Lower Siwaliks (Upper Miocene), India. After Pilgrim.
B. *Simia satyrus.* After Selenka.
C. *Simia satyrus.* After Selenka.

This anthropoid is represented only by the third upper molar of the right side (pl. 2, fig. 9). As observed by Pilgrim this tooth distinctly foreshadows that of the orang, in its general pattern and in the characters of the enamel folds and wrinkles, the differences all being obviously primitive characters. This specimen comes from a low horizon (Chinji zone) and its characters suggest that the orang line had even at that time become rather widely separated from the forerunners of the chimpanzee and gorilla. Accordingly, Dr. Pilgrim considers *Palæosimia* "as branching off from the *Dryopithecus* line previous to the chimpanzee and gorilla and passing through a marginal hypothetical species of *Dryopithecus*" (p. 67).

Sivapithecus indicus *Pilgrim.*

Figs. 13A, 14A, 15A, 16A.

This highly important genus and species were originally established on a third right lower molar (Pilgrim 1915, pl. 1, fig. 7) from the Chinji zone of the Lower Siwaliks, but the author employs as a neotype or topotype (wrongly called "type") a specimen from the same locality and level consisting of a right mandibular ramus (pl. 1, fig. 7), containing in excellent preservation the second and first molars, the posterior premolar and portions of the roots or alveoli of the anterior premolar and canine. A supplementary series from a later horizon (the Nagri horizon of the Middle Siwaliks is referred by the author to the same species and consists of: (*a*) a fragment of the mandibular symphysis (pl. 2, figs. 1, 1a–d) containing the left canine and parts of the roots and alveoli of the incisors and front premolar; (*b*) a front lower premolar (pl. 1, figs. 9, 9a, 9b); a lower molar (not figured). An upper canine from the Lower Siwaliks of Chinji (pl. 2, figs. 3, 3a–d) is provisionally referred to the same genus, while a fragment of the right maxilla (pl. 2, fig. 2) containing the much worn first and second upper molars are doubtfully referred to this genus.

After an exceedingly detailed study of these precious fragments Dr. Pilgrim has attempted a preliminary and partly hypothetical restoration of the mandible of *Sivapithecus* in left side view and as seen from above. The reviewer has given prolonged consideration to this restoration, first with reference to the propriety of associating the scattered fragments in a single generic concept and secondly with reference to the placing and orientation of the various parts. While the generic association of the fragments seems probable the reviewer has been led to a different conception of the jaw as a whole.

This anthropoid shows a rounding and broadening of the molar crowns.

which in these particulars foreshadow the human type, although the first and second molars are more primitive and less widened than in man. The molar crowns present a widened modification of the "*Dryopithecus* pattern," described below, a pattern which is further obscured in man; the posterior premolar is bicuspid, and foreshadows the human type. Although the lower border of the mandible is not preserved, enough remains to show that the mandible was deep and massive, as it was in all early anthropoids and men. The ascending ramus was undoubtedly wide, as indicated by the forward

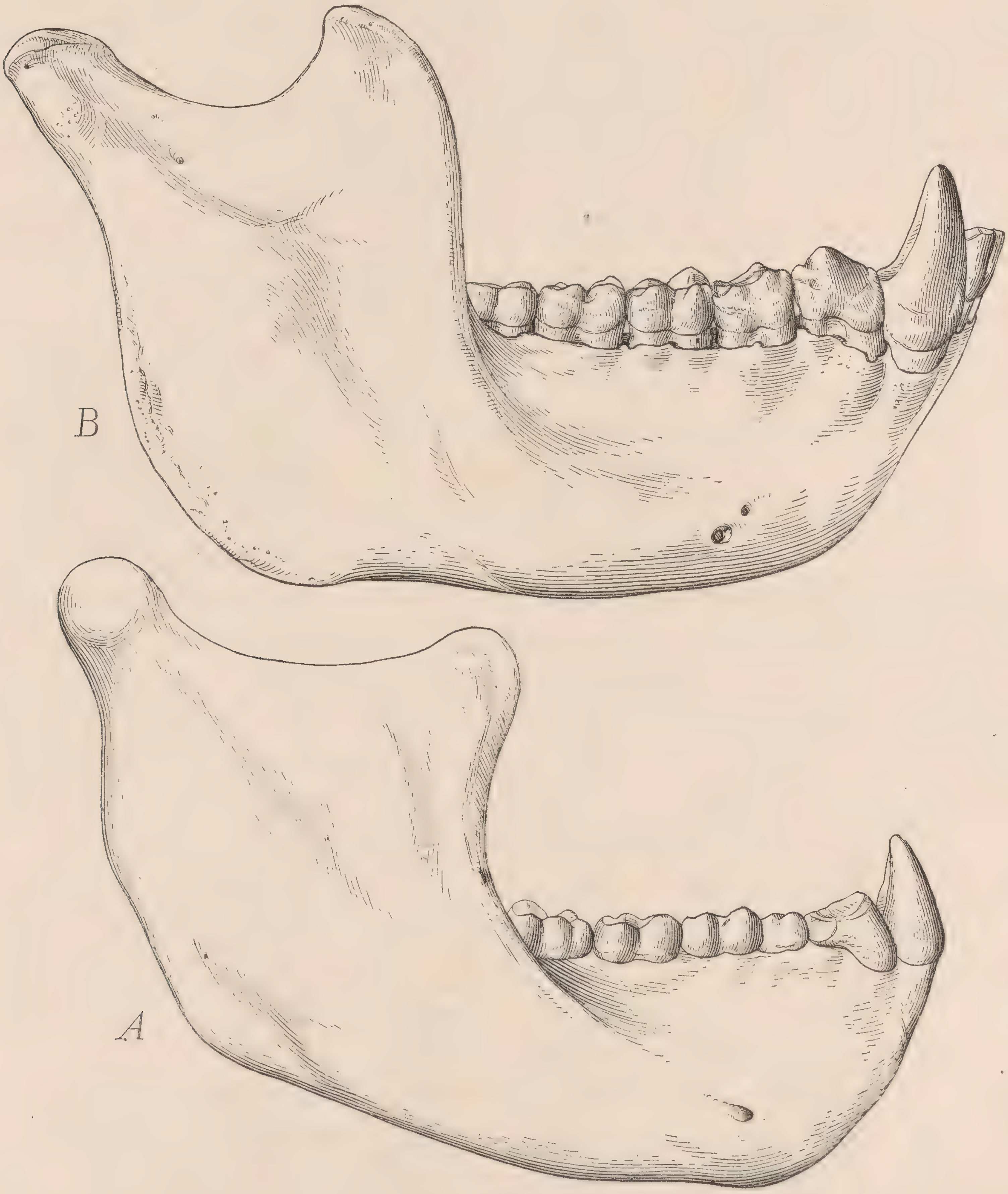

Fig. 13. Comparison of *Sivapithecus* and *Simia*. Side view of lower jaw. Both figures × $\frac{2}{3}$.
A. *Sivapithecus indicus*. Partly hypothetical and provisional restoration by Pilgrim.
B. *Simia satyrus*. Male specimen.

extension of its lower outer ridge and by the massive character of the mandible.

One of the most noteworthy human characteristics of *Sivapithecus* is the remarkable agreement in the breadth indices of all the lower cheek teeth as given by Dr. Pilgrim as follows:

	Sivapithecus	Man
m_3	93.7	91.6
m_2	94.6	94.4
m_1	92.1	92.
pm_4	116.5	112.7
pm_3	110.1	111.6

The premolars also approach the human type in fundamental pattern.

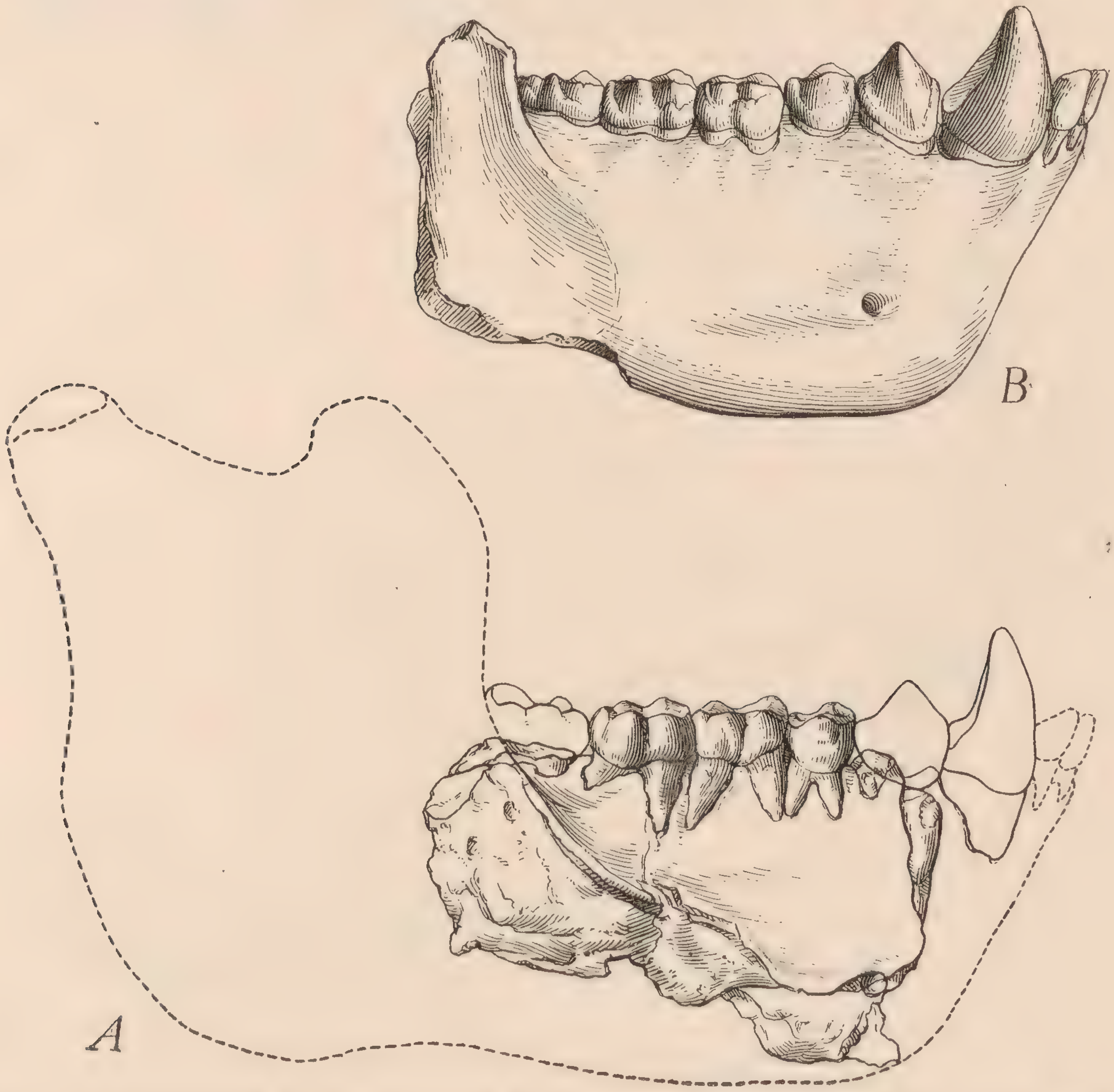

Fig. 14. Comparison of *Sivapithecus* and *Dryopithecus*. Side views of lower jaw. Both figures $\times\frac{2}{3}$.

A. *Sivapithecus indicus.* New restoration based on casts of the original specimens. Side view (Compare fig. 13A).

The fully shaded part represents the topotype or principal specimen. The third molar (outline) is the type. The canine and anterior premolar are referred specimens belonging to other individuals. The anterior premolar may be somewhat too large. The dotted parts are hypothetical.

B. *Dryopithecus fontani.* From Branco, after Gaudry.

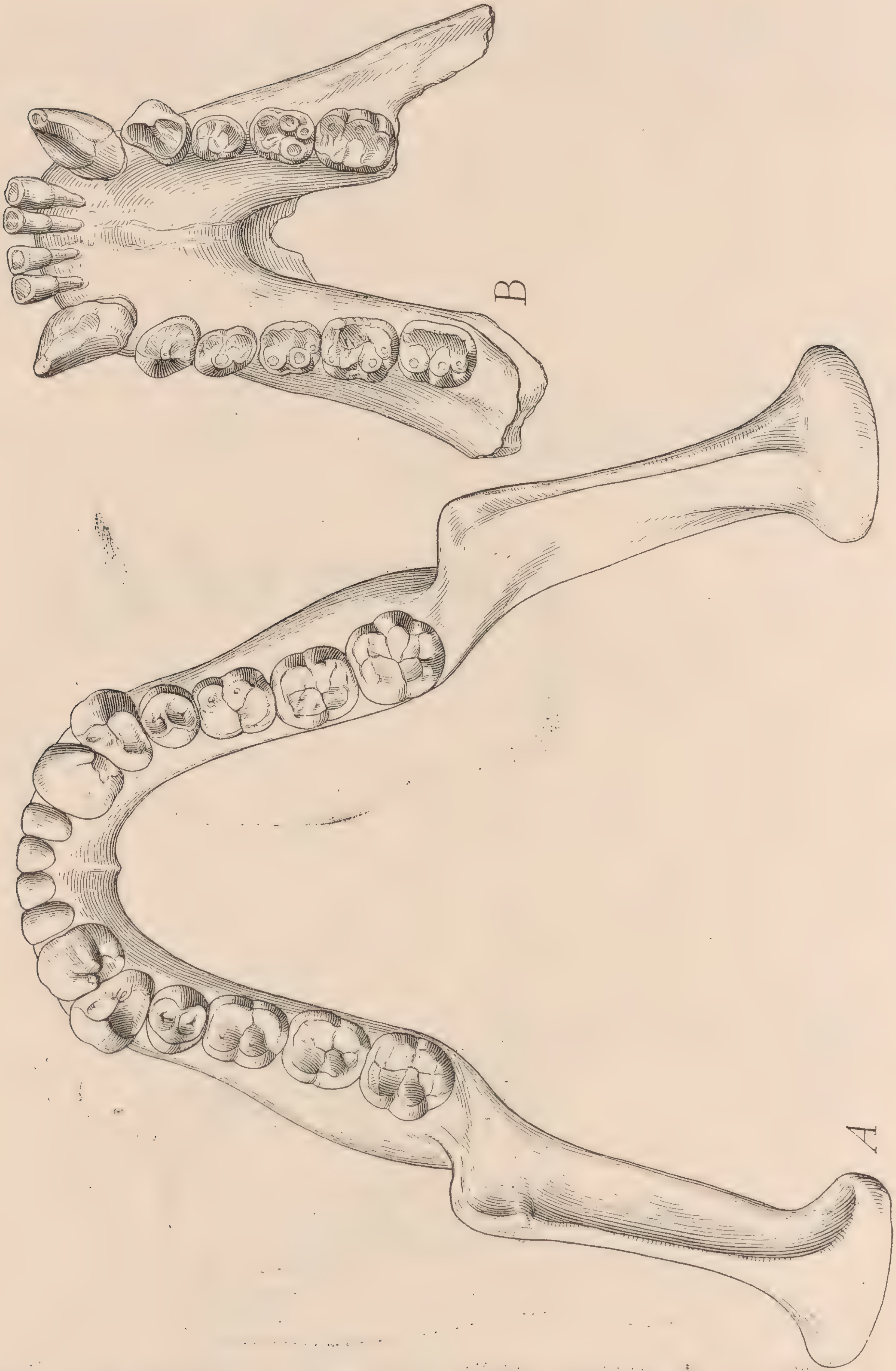

Fig. 15. Comparison of *Sivapithecus* and *Dryopithecus*. Lower jaws, top view. × $\frac{2}{3}$.

A. *Sivapithecus indicus*. Provisional and partly hypothetical restoration by Pilgrim. The subhuman character of the *Sivapithecus* jaw and dentition, as thus represented, is criticised adversely in the text.

B. *Dryopithecus fontani*. Upper Miocene, Europe. After Branco.

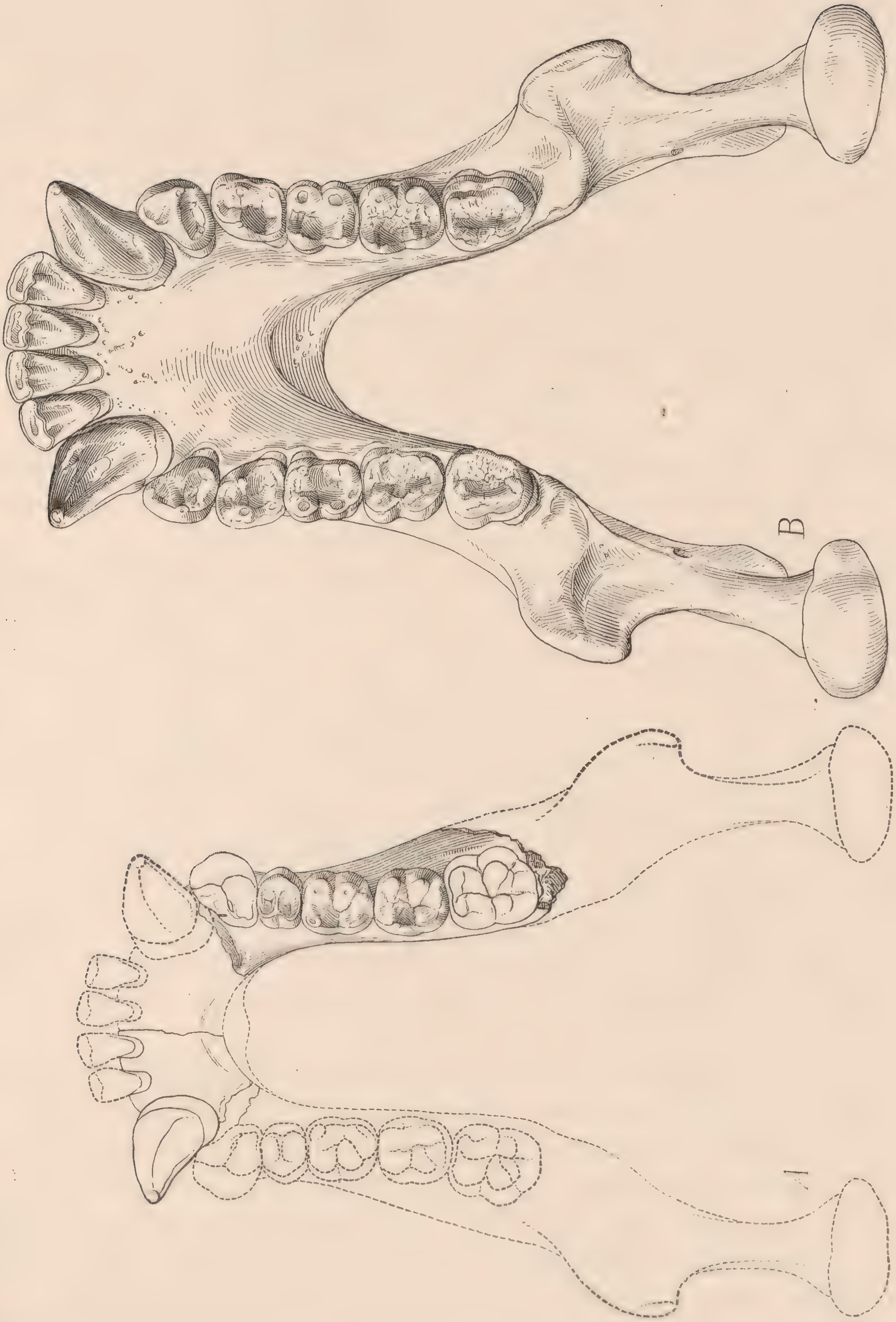

Fig. 16. Comparison of *Sivapithecus* and Orang. Lower jaws, top view. × $\frac{2}{3}$.
A. *Sivapithecus indicus.* New restoration. Compare with Fig. 15A, B. Conventions as in Fig. 14A. The anterior premolar is probably too large.
According to the author's view *Sivapithecus* is nearly allied to *Dryopithecus*.
B. Male Orang jaw.

In Dr. Pilgrim's provisional restoration the symphysis is very short; the canines are set more internally to the front premolars, as in man, instead of fully in front of them, as in typical anthropoids, and the opposite halves of the mandible are made more divergent than in anthropoids.

Among my reasons for doubting the accuracy of Dr. Pilgrim's restoration are the following:

First, that, so far as it is preserved, the jaw fragment and all the cheek teeth are unquestionably closer in structure to *Dryopithecus* and even to the orang than they are to *Homo*. The same is true of the referred canines.

Secondly, when the three molars and posterior bicuspid are placed parallel to those of an orang the premolar and canine alveoli also agree in general position and the canine is not much if any more internal to the anterior premolar than it is in some orangs.

Thirdly, the presence of a heavy ape-like canine and anterior premolar seems quite inconsistent with the extremely shortened symphysis assigned to *Sivapithecus* in Dr. Pilgrim's provisional restoration.

Fourthly, I think that Dr. Pilgrim's figures of the symphysial fragment (pl. 2, figs. 1–1a) are not *true* side, top, front and inside views but all oblique views, which foreshorten the apparent length of the symphysis and cause the canine to appear too far internal to the front premolar.

Fifthly, the teeth and the front part of the jaw are very different in details from those of *Homo heidelbergensis, H. neanderthalensis* (Krapina jaws) or any other known human types.

In brief I would be inclined to restore the *Sivapithecus* jaw more after the pattern of a female orang than after that of early races of man. Conceivably *Sivapithecus* might be related to *Palæosimia* which is known only from a third upper molar. This is a well rounded tooth, as is also the third lower molar of *Sivapithecus,* but is distinguished by the wrinkling of the enamel.

By far the most unhuman features of the *Sivapithecus* jaw are the ape-like canine and front premolar. Those investigators who do not accept as a fact the frequent reversal of evolutionary tendencies, who expect very remote ancestors to foreshadow all the characters of their specialized descendants, and who, not finding such ancestors, make every group indefinitely polyphyletic and push all phyletic lines backward as nearly parallel lines meeting only at excessively remote periods, will undoubtedly see in the ape-like canines and front premolars of *Sivapithecus* an almost insuperable objection to close kinship with man. They will regard this genus as merely an extremely brachycephalic offshoot of the *Propliopithecus-Dryopithecus* group with no special affinity to the Hominidæ. At the other extreme Pilgrim would remove it very far from all the Simiidæ and place it in or near the ancestral line of the Hominidæ, finding the common stem of Simiidæ and Hominidæ only in a remote and unknown Eocene common stock.

The presence of ape-like canines and front lower premolars does not in itself necessarily exclude *Sivapithecus* from kinship with man, but rather, as Dr. Pilgrim thinks, it may well be a character which should perhaps be expected in a mid-Tertiary human precursor. However, even if it should be thoroughly established that *Sivapithecus* is directly ancestral to the Hominidæ, this would not, in the reviewer's opinion, warrant its removal from the Simiidæ to the Hominidæ, unless it could be shown that in the totality of its skeletal characters the genus was more manlike than ape-like.

Dryopithecus *Lartet.*

(Figs. 14B, 15B, 17D, 18–21 24B, 25B, C).

The genus *Dryopithecus* was formerly known only in the Upper Miocene and Pliocene of Europe. Several lower jaws with teeth have been described by Lartet, Gaudry, Branco, Harlé, A. S. Woodward. Isolated lower molars have been described by Branco, Abel, Schlosser and others. A couple of upper molars have been figured by Branco. The Indian material referred to this genus by Pilgrim is of similar fragmentary character, but is of great importance not only in further emphasizing the faunal affinities of the Siwalik series with the Upper Tertiary of Europe, but also in its bearing on the phylogeny of the anthropoids.

The pattern of the lower molars of *Dryopithecus* may be broadly described as follows: There are five main cusps, three of which (protoconid, hypoconid, mesoconid) are on the external side of the crown and two (metaconid, entoconid) on the internal side. The metaconid, which is the highest cusp, is directly internal to the protoconid; the hypoconid is opposite the valley between the metaconid and the entoconid; the mesoconid (or hypoconulid) is on or near the postero-median border of the tooth, behind the hypoconid and entoconid. The external basal cingulum is more or less reduced but sometimes persists opposite the posterior part of the protoconid. In front of the protoconid and metaconid is a remnant of an earlier trigonid basin in the form of a transverse valley; into this depression fitted the hypocone of an upper molar. At the back of the tooth there is a very thick cingulum which sometimes is confluent with the mesoconid. The surface of the lower molar crown is likewise characterized by the arrangement of certain furrows; the hypoconid is limited anteriorly and posteriorly by two deep transverse furrows which converge into a prominent inverted V(Λ), the narrow end of which is at the centre of the crown. From the narrow end and sides of this truncated V other furrows radiate as follows: (a) an anterior central furrow between the protoconid and metaconid, (b) a posterior central furrow between the mesoconid and entoconid and (c) one or two internal furrows between the metaconid and entoconid.

This general pattern is not only characteristic of all species of *Dryopithecus* both European and Indian, but also of the new genus *Sivapithecus* which Pilgrim regards as ancestral to *Homo sapiens*. The *Dryopithecus* lower molar without doubt also reveals the fundamental ancestral pattern in the Orang, Gorilla, Chimpanzee and even Man, but it is more or less masked in each of these genera by secondary modifications. Judging from many analogies in other mammalian groups the *Dryopithecus*-pattern was ultimately derived, I believe, from the very primitive pattern exhibited in the genus *Parapithecus* Schlosser from the Lower Oligocene of Egypt; which is also structurally ancestral to the *Propliopithecus*-Gibbon series.

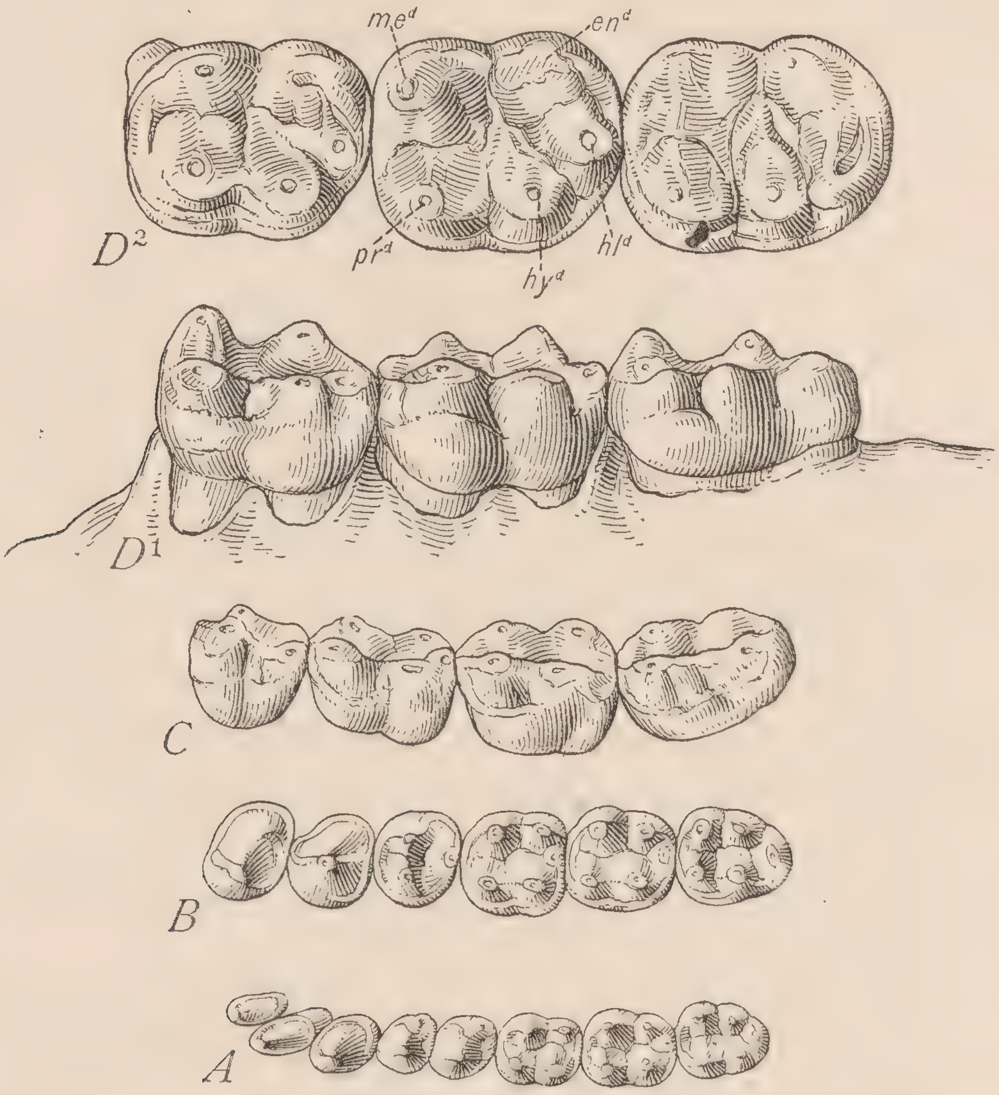

Fig. 17. Comparison of lower teeth of *Parapithecus, Propliopithecus, Pliopithecus, Dryopithecus.* $\times \frac{3}{2}$.

A. *Parapithecus Fraasi.* Lower Oligocene, Fayûm, Egypt. After Schlosser.
B. *Propliopithecus Haeckeli.* Lower Oligocene, Fayûm, Egypt. After Schlosser.
C. *Pliopithecus antiquus.* Lower Pliocene, Europe. Oblique view. After Abel.
D^1, D^2. *Dryopithecus fontani.* Upper Miocene, Spain. After Smith Woodward. D^1 outer side, D^2 crown view.

Although this conception of the morphology and relationships of the *Dryopithecus* molar is based upon the specimens figured by Gaudry, Schlosser, Abel, Branco, Harlé, Pilgrim and others, none of these authors should be considered as responsible for the present interpretation and formulation of the facts.

Difficulty has been caused by the shifting relations of the hypoconulid ("mesoconid") to the mid-line in *Dryopithecus* and other Primates. Branco, Schlosser, Abel and Pilgrim seem to have assumed that the primitive position of the hypoconulid is on the outer side of the crown in line with the protoconid and hypoconid and they speak frequently of an "inward displacement of the mesoconid." But a central position of this cusp is the primitive condition in many mammalian groups. It is seen in the Lower Eocene Anaptomorphidæ, it persists in the oldest known anthropoids *Propliopithecus* and *Parapithecus* from the Lower Oligocene of Egypt and continues into the *Pliopithecus*-gibbon line. Its position is variable in *Dryopithecus,* where it is occasionally more or less displaced toward the outer side as it is more or less in the Orang, Chimpanzee, Gorilla and *Eoanthropus.* In all genera it is more central in the conservative first lower molar than in the more progressive second and third. It strikes behind the inner part of the metacone and externally to the hypocone of the upper molars. In the milk teeth it is often more or less central in position. In *Sivapithecus* it is intermediate in position, somewhat further inward than in Abel's "Second Type" of *Dryopithecus fontani.* In man it is usually more median in position, especially in m_1, but is occasionally somewhat displaced to the outer side. The median position of the hypoconulid in man may be either a primitive or a secondary character. The frequent disappearance of the hypoconulid on the second and third molar in man is correlated with the rounding of the whole molar crown and with the rotary action of the lower jaw.

Dryopithecus chinjiensis *Pilgrim.*

(Figs. 18A and Part I, Fig. 18A).

The type consists of an isolated third lower molar (op. cit., pl. 2, figs. 6, 7) from the Chinji horizon of the Lower Siwaliks. The author assigns this tooth to the genus *Dryopithecus* with some doubt; but that is evidently only because nowadays "genera" are about equivalent to the old-fashioned "good species." The author's excellent figure of the type clearly reveals the generic pattern as described above and the differences between this tooth and those referred to *D. fontani* of Europe are no greater than the differences between the latter and the type of *D. darwini.* The author suggests (p. 66) that *D. chinjiensis*" . . . . might indeed even be the direct ancestor of the Gorilla," and a careful comparison of the figures of the first and third lower molars (the only ones known) reveals striking fundamental resemblances to the corresponding teeth of the Gorilla, the differences being all apparently primitive characters.

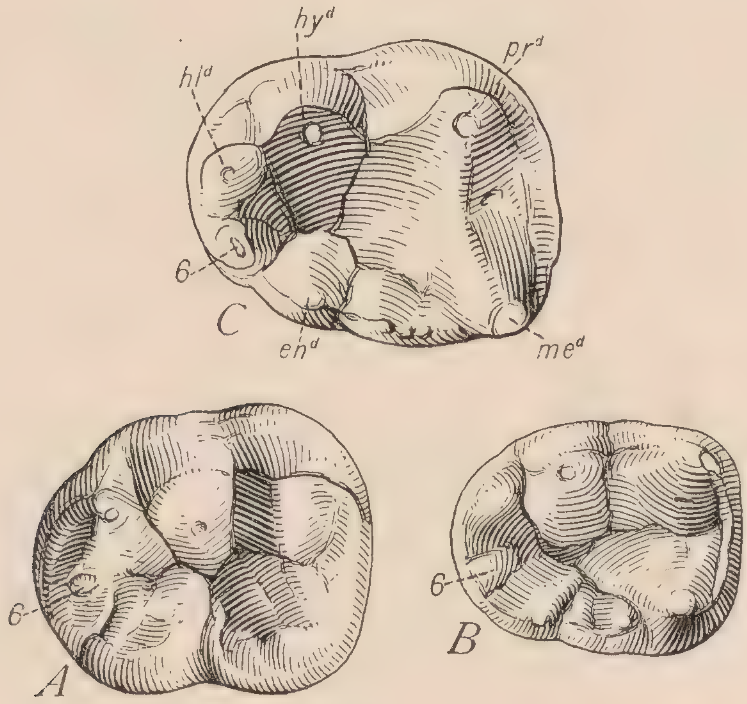

Fig. 18. **Comparison of the third left lower molar of** ***Dryopithecus chinjiensis*** **(A),** ***D. punjabicus*** **(B) and** ***Gorilla*** **sp. (C).** × $\frac{3}{2}$.
A and B after Pilgrim.

Dryopithecus punjabicus *Pilgrim.*

(Figs. 18B, 19B, 20A, 25B, 34A.)

The specimens referred to this species are believed to have come from the summit of the Chinji zone (Lower Siwaliks) and from the lower part of the Nagri zone (Middle Siwaliks). The type consists of parts of the mandible containing the third right lower molar and the second left lower molar. The third lower molar shows all the generic characters above noted; its specific characters need not be considered here, except to note that it is elongate tapering posteriorly, with low cusps, and with the internal margin

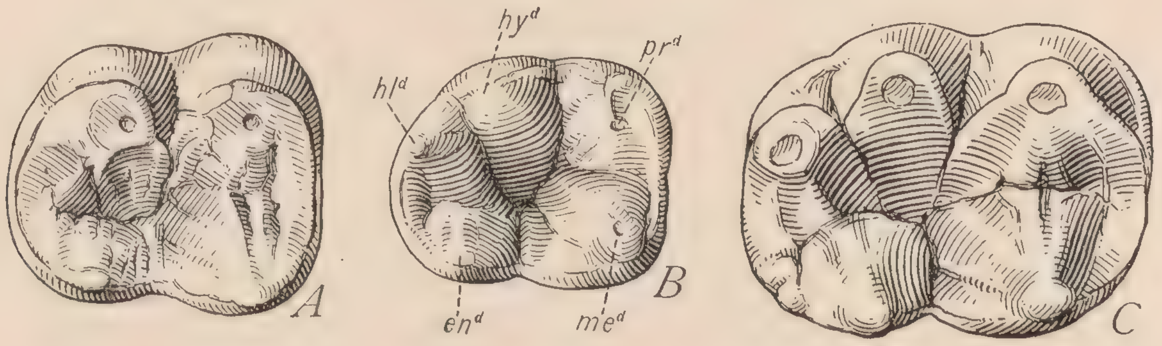

Fig. 19. **Comparison of the second left lower molar of** ***Dryopithecus punjabicus*** **(B), Orang (A) and Gorilla (C).** × $\frac{3}{2}$. **B after Pilgrim.**

broken up into numerous small cusps by sharp transverse furrows. It is more primitive than the third lower molar of the Chimpanzee and it also suggests the contour of the third lower molar of the Gorilla. The second lower molar is elongate, narrow posteriorly and has an accessory cusp behind the metaconid. (Apparent vestiges of this cusp appear in certain chimpanzees).

The author refers to this species a specimen from the Nagri horizon of the Simla Hills, which is highly important, since it is a maxilla containing both premolars and the first and second molars in excellent preservation (pl. 3, figs. 1, 2). The author observes that in comparison with the upper molars of the European species of *Dryopithecus* (as figured by Branco and by Schlosser) the Indian specimens agree so closely, apart from minute differences, as to make it fairly certain that they belong to the same genus. The author refers it to *D. punjabicus* on account of the "remarkable analogy in

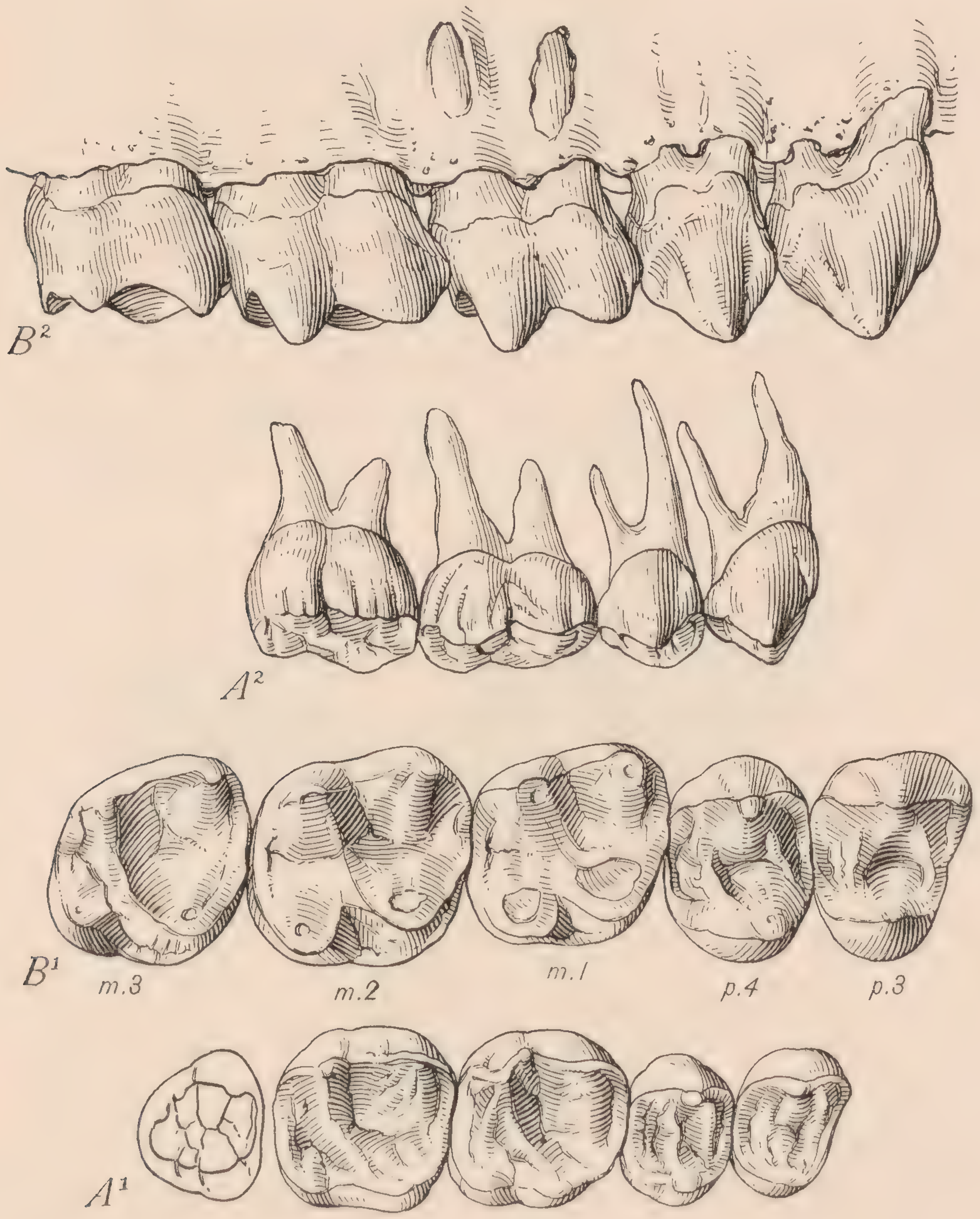

Fig. 20. Comparison of upper cheek teeth of *Dryopithecus punjabicus* (A^1, A^2) and Gorilla (B^1, B^2). × $\frac{1}{1}$.

A^1, A^2 after Pilgrim.

structure and ornamentation of these molars and those of the Chinji mandible" (type), special points of resemblance being the serration of the outer edge of the tooth, the lowness of the cusps and the complex character of the enamel folding. To the reviewer these upper teeth, as well as the isolated ones figured in Pl. 2, figs. 4, 5, bear also a highly significant resemblance to those of both the Gorilla and the Chimpanzee, not only in the general plan of each premolar and molar but also in a great many details.

Dryopithecus giganteus *Pilgrim.*

(Fig. 21 B.)

This species comes from a higher horizon, very near the boundary between the Lower and Middle Siwaliks, and is referred to the Nagri horizon of the Middle Siwaliks. The type and only known specimen is a third right lower molar, which is not only much larger than that of any other species of the genus but is much larger than that of the Chimpanzee, in which this tooth is more or less retrogressive. To the reviewer this tooth is curiously suggestive of the corresponding tooth in certain chimpanzees, especially in the general pattern, course of all furrows, character and position of the wrinkles, the most important difference being the greater size and the fact that in the modern genus the posterior part of the tooth is usually narrower. *D. giganteus* therefore appears to be rather closely allied to the ancestors of the Chimpanzee. The wide range in size in the species of *Dryopithecus* is noteworthy.

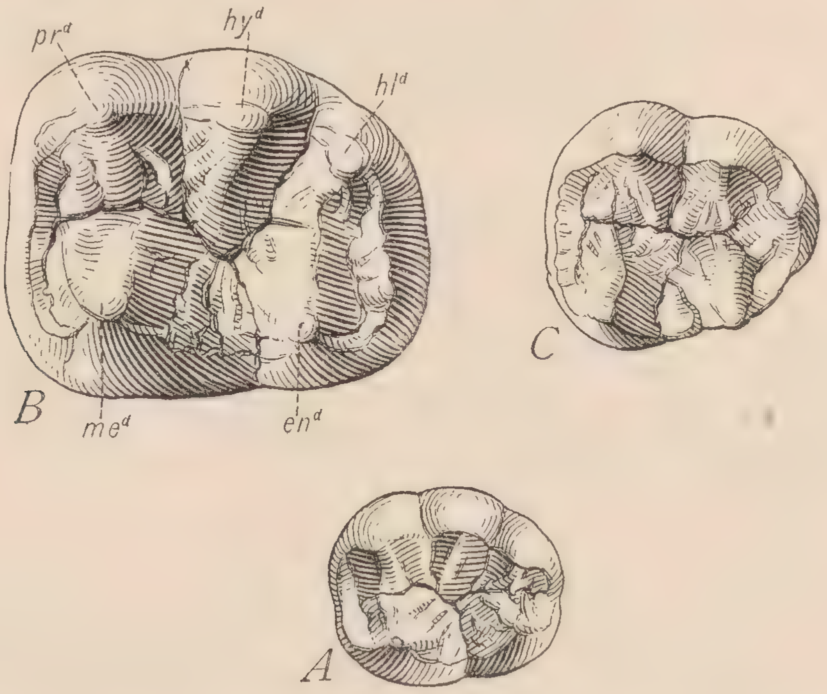

Fig. 21. Comparison of third right lower molar of *Dryopithecus rhenanus* (A), *D. giganteus* (B) and Chimpanzee (C). × $\frac{3}{2}$.
A from a cast of a specimen figured by Branco.
B from a cast of the type.

Palæopithecus sivalensis *Lydekker.*

(Fig. 22 B, C.)

The type consists of a palate containing the teeth of one side except the incisors. The horizon is the Dhok Pathan zone or Upper Middle Siwaliks, regarded as of Pontian or Lower Pliocene age. Lydekker referred this specimen to a new genus *Palæopithecus* in 1879, but later (1886, p. 3) came to the conclusion that it was "an ape generally distinct from both *Gorilla* and *Simia,* but so close to *Troglodytes* [the Chimpanzee] as to leave little doubt as to its identity — an identity rendered the more probable by the occurrence of *Cynocephalus* in the same region. In those respects

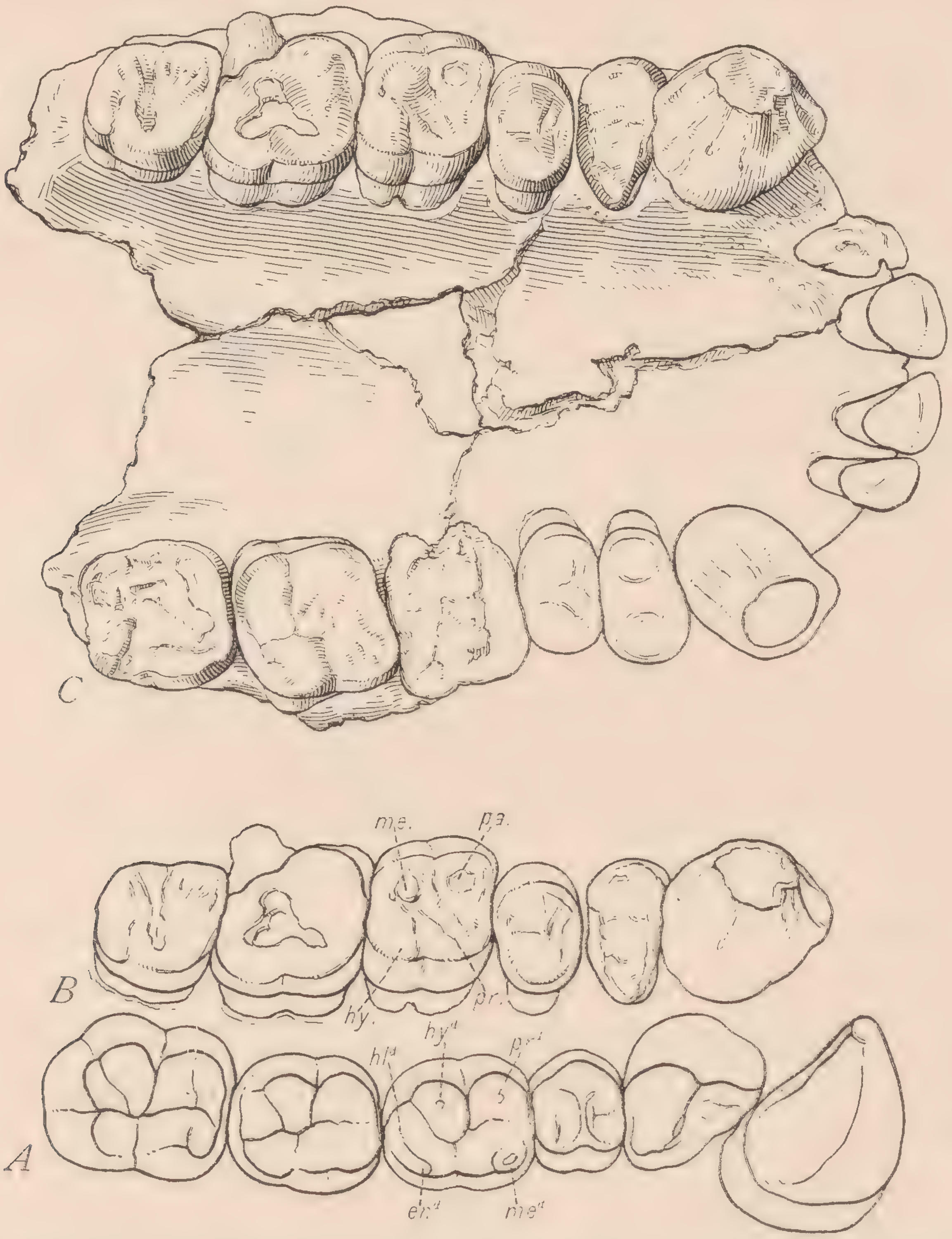

Fig. 22. Upper teeth and palate of *Palæopithecus sivalensis* (C). After Dubois. $\times \frac{1}{1}$.
Upper teeth of *Palæopithecus* (B) compared with lower teeth of Sivapithecus (A).
The canine, anterior premolar and third molar of *Sivapithecus* belong to different individuals.
The relations between the lower teeth of *Sivapithecus* and the upper teeth of *Palæopithecus* seem hardly close enough to be indicative of generic affinity.

in which the Siwalik *Troglodytes* differs from the existing African species it shows in a still more marked degree the approach to the human type of dentition presented by the latter, and serves, in a small degree, to bind still closer the connection between the *Simiidæ* and the *Hominidæ*. In the inclination of the two series of cheek-teeth and the relative lateral position of the premolars to the true molars the genus *Hylobates* makes an approach to the human type which is wanting in all the larger existing Simiidæ, and it is very noteworthy to find a similar relation obtaining in the Siwalik *Troglodytes*, accompanied by a more human-like structure of the upper premolars."

Dubois (1897) dissented from Lydekker's conclusions, gave a corrected figure of the type and concluded that one should rather assign to *Palæopithecus* a position in the family Simiidæ lower than that of any of the four living genera (p. 90); also (p. 96) that the Indian *Palæopithecus* may have been a later member of an older group of anthropoids that included the European Miocene genera *Pliopithecus* and *Dryopithecus*.

Dr. Pilgrim (1915) gives an extended analysis of the known characters of *Palæopithecus*, in which he lists eleven characters in which the type differs from the chimpanzee, seven in which it differs from man, three which distinguish it from *Dryopithecus* and so forth. To the reviewer many of the characters which distinguish *Palæopithecus* from both the chimpanzee and the gorilla appear to be simply primitive characters, which may either prove to be characteristic of the Upper Siwalik ancestors of these apes, or may at that time have been retained by *Palæopithecus* as a conservative genus. The narrow palate, relatively small incisors and slightly convergent tooth rows are, for excellent reasons, to be ascribed to the ancestral anthropoids, since the opposite characters are characteristic specializations of all the larger existing Simiidæ. In the existing chimpanzee, which is strongly brachycephalic, the upper cheek teeth are evidently beginning to suffer retrogressive changes such as have been carried to far greater lengths in brachycephalic races of man. Thus, the molars are assuming a rounded or subcircular contour, while the number of internal roots in the molars and of external roots in the premolars is apparently in process of reduction, by coalescence, from two to one. Hence in *Palæopithecus*, a more primitive anthropoid, it is not surprising to find more distinctly quadrilateral molars, with two distinct internal roots, and wider premolars with two distinct external roots.

Several of the characters in which *Palæopithecus* differs from the chimpanzee bring it closer to the gorilla: here belong the stouter canines, the somewhat higher cusps of the molars, the more quadrilateral molars, the greater width of the anterior premolars. To the reviewer it seems closer to the gorilla notwithstanding the laborious arguments of Dubois and Pilgrim.

The dentition as a whole is also similar to that of *Dryopithecus punjabicus*, from which *Palæopithecus* may well be descended.

Pilgrim notes that it resembles *Pliopithecus* especially in the width and shortness of the premolars and first molar, the narrow palate and straight tooth row, the small incisors and general characters of the molars, so that as already said Pilgrim and Dubois regard it as a relative of *Pliopithecus*, from which according to Pilgrim it is distinguished by its greater size (the tooth row being nearly as long as in a chimpanzee), wrinkling in the enamel and reduction of the internal cingulum. The reviewer, on the other hand, regards the points of resemblance to *Pliopithecus* as all primitive characters.

Palæopithecus also resembles the Lower Siwalik genus *Sivapithecus* Pilgrim (to be noted below), in the general appearance of the molars, with relative width of the molars and anterior premolars, in the height of the cusps and in the amount and character of the wrinkling of the enamel. Lydekker indeed suggested that the jaw of *Sivapithecus* should be referred to *Palæopithecus*, a suggestion that has not yet been definitely disproved, since Dr. Pilgrim's principal objection to it is the assumed wide difference in the front part of the lower jaw in *Palæopithecus* and *Sivapithecus;* but this difference does not exist, if the reviewer's restoration of *Sivapithecus* is more correct than that of Dr. Pilgrim.

In brief I think that Dubois and Pilgrim have largely misinterpreted the relationships of *Palæopithecus* and that it is quite close to the ancestor of the Gorilla, from which it differs only in primitive characters.

V. THE EXTINCT ANTHROPOIDS AND MEN OF EUROPE; ALSO PITHECANTHROPUS.

Pliopithecus antiquus *Gervais.*

(Figs. 10C, 11C, 23A).

This Upper Miocene and Lower Pliocene genus has been regarded by nearly all authors except Dubois (1897) and Pilgrim (1915) as an ancestral Gibbon, Hoffman (1893) after a very careful investigation even placing it in the genus *Hylobates*. Its resemblances to the Gibbons are indeed so numerous and so fundamental that I do not doubt that it is at least nearly related to that group and in most if not all characters structurally ancestral. Dr. Pilgrim (1915) on the contrary thinks it is excluded from the direct ancestry of the Gibbons by at least the following characters: "1) The greater proportionate breadth of the teeth in the front of the jaw in *Pliopithecus*, particularly marked in the case of pm_3, but noticeable in all the premolars, upper as well as lower, and in the first molar above and below.

2) The much longer symphysis in *Pliopithecus*.

3) The greater divergence of the mandibular rami."

But, to deal with these in reverse order, why is the greater divergence of the mandibular rami regarded as a specialization in *Pliopithecus*, and why are the more parallel rami of the Gibbons regarded as more primitive? From the reduction of the dental formula and crowding out of one pair of incisors and the two anterior pairs of premolars in all Old World Anthropoidea, and from the evidence that all this series eventually ran back into small insectivorous-frugivorous, short-faced lemuroids analogous to *Necrolemur* and the Anaptomorphidæ it seems quite probable that in the remote ancestors of the series the front of the jaw was quite narrow, with small semi-procumbent canines and incisors, the mandibular rami divergent rather than parallel. Such a jaw, as shown above, is already known in the Lower Oligocene *Parapithecus*. On the other hand the parallel rami, wide muzzles and chins of the Gorilla, Chimpanzee and Orang are obviously correlated with the widened incisors and tusk-like canines. The Gibbon, too, has acquired almost sabre-like, widespread, although slender, upper canines, and somewhat wider incisors; in connection with these features its jaw has widened distally and its mandibular rami have become parallel rather than convergent. To the same sabre-like form of the canines as a primary adaptation may reasonably be credited the elongate compressed form of the front lower premolar, as

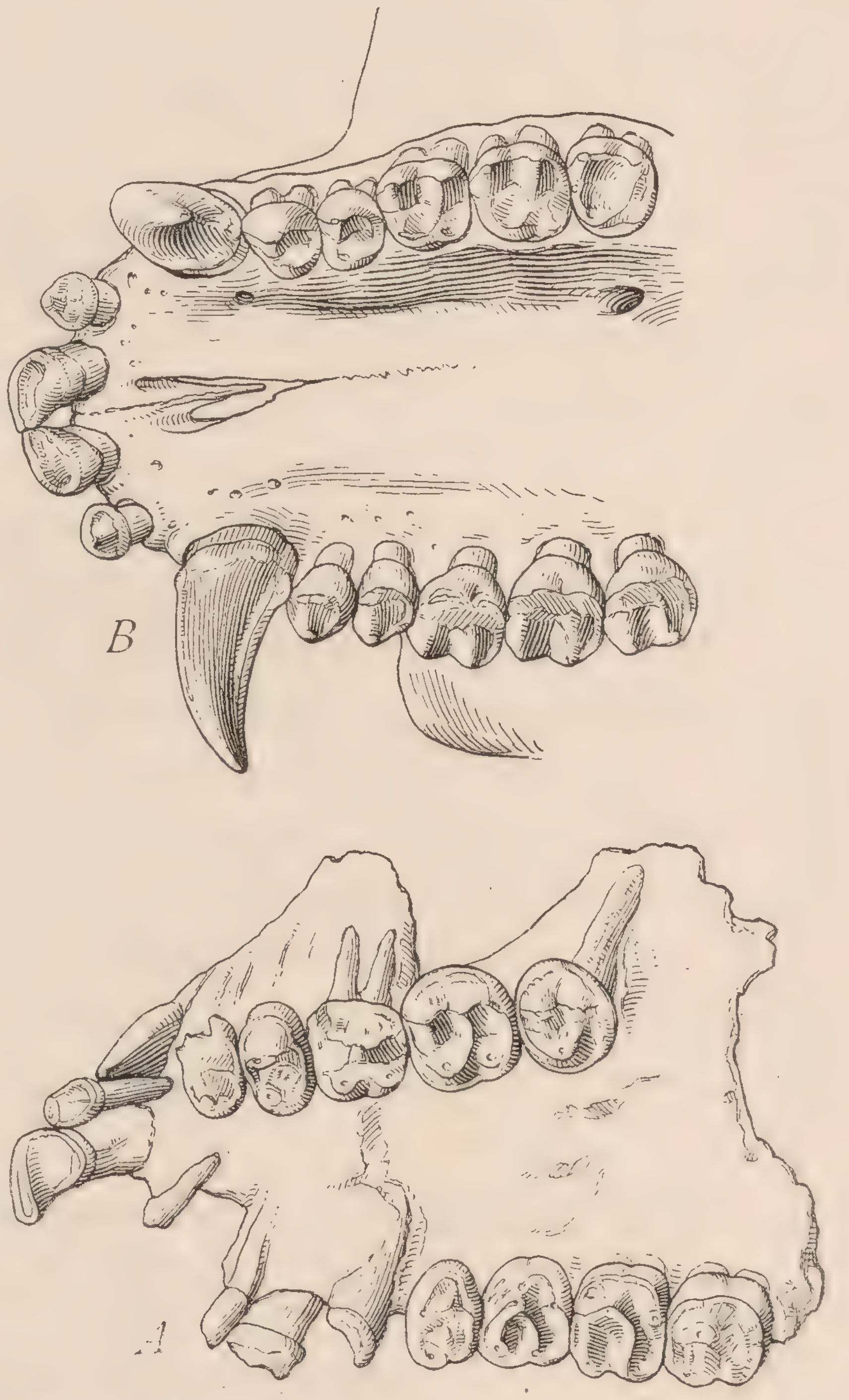

Fig. 23. Upper teeth and palate of (A) *Pliopithecus antiquus* (after Hoffmann) and (B) *Hylobates lar*. Both figures × $\frac{1}{1}$.

This figure well illustrates the relatively close structural and genetic relationships of these genera. The modern genus has become specialized in the widening of the median incisors, in the laniary form of the canines, in the anteroposterior elongation of the premolars and in the reduction of the cingulum of the molars.

well as the oblique downward prolongation of the front portion of its crown, features developed in far greater degree in the baboons, where their association with the tusk-like form of the upper canine is very obvious. *Pliopithecus* on the other hand in the divergent rami, in the smaller canines and in the wider premolars has retained the characters seen in greater emphasis in the far older Oligocene genus *Parapithecus.*

The greater width of the upper premolars in *Pliopithecus,* as compared with the Gibbons, means only that in the Gibbons the relative anteroposterior diameter of these teeth has increased, perhaps in correlation with a slight lengthening of the premolar region in the lower jaw, and the same is true of the greater relative width of the first upper and lower molars. As noted above in many mammals there is often a tendency for molars to transform from a relatively wide and triangular crown to an anteroposteriorly elongated quadrangular crown. This tendency has affected the Gibbon far less than the Gorilla, but the Gibbon has not escaped it entirely as the foregoing comparison with *Pliopithecus* indicates. The greater breadth of the lower premolars in *Parapithecus* and *Propliopithecus* by no means excludes them from the ancestry of the Gibbons. In the remote forerunners of the whole anthropoid series there was as above noted a marked fore-and-aft crowding of the front of the jaw, a process seen also in the Anaptomorphidæ, where it also results in a relative widening of the premolars.

As for the much longer symphysis in *Pliopithecus,* that is associated perhaps with the far heavier mandibular rami, very wide ascending ramus and heavy jaw muscles. Such a type of jaw is clearly foreshadowed in *Propliopithecus* and is carried to an extreme in the male Orang. While there is a truly amazing variation in the form of the jaw in the Siamang, as shown by Bolk (1915), the very slender jawed types with a weak symphysis have a degenerate look, which as in the case of certain Cebidæ and Lemuridæ is, I believe, a late acquisition.

Among the characters which in Dr. Pilgrim's view tend to exclude *Propliopithecus* and *Pliopithecus* from the ancestry of the Gibbons is "the fact that m_3 is shorter than m_2." "There can, however, be no doubt," continues Pilgrim (p. 63), "that the latter character is typical of an advanced stage of evolution." But in the far older Anaptomorphidæ of the Lower and Middle Eocene m_3 is usually a *smaller* tooth than m_2 and is sometimes even shorter. The further fact that it is shorter than m_2 in both the known Oligocene genera, *Propliopithecus* and *Parapithecus,* suggests that this is a primitive character rather than that these genera should be excluded from the ancestry of *Propliopithecus* and the Gibbons.

"The question of the canines in this branch merits consideration," says our author (*loc. cit.*). "Are the small canines in *Propliopithecus* an instance of precocious reduction, similar to what has occurred at an extremely recent period in the case of the *Hominidæ,* or were the canines of the Anthropoidea primitively small? The answer to this can only be hazarded as a guess." But to the present writer the evidence on this matter seems fairly decisive. The canines are quite small in most of the Lower Eocene Anaptomorphidæ and in the oldest known Anthropoid, *Parapithecus.* In *Propliopithecus, Pliopithecus* and *Dryopithecus* the progressive enlargement of the canines can be traced to its extreme development, in the modern giant apes. Dr. Schlosser's view is that in the Primates generally the canine may have originated as a front premolar which gradually became caniniform, and that the original lower canine came to function as an incisor. This hypothesis, although favored by Dr. Pilgrim (p. 64), is, in my judgment, totally erroneous and based upon a false analogy supplied by the Lemuridæ. For the lower canine of all anthropoids and in the Adapidæ and Cebidæ fits in front of the first maxillary tooth, which is surely an upper canine. Hence the lower canine of anthropoids is homologous with the lower canine of lemuroids.

In conclusion it may be remarked that the present writer during the past fifteen years has had perhaps unusual opportunities for studying the evolution of the teeth in many phyla of mammals. From this experience has grown the impression that mere quantitative differences in degree, or proportion, should not, in themselves and without further evidence, be deemed sufficient to exclude an earlier form from the ancestral line of a later form. In many cases I believe there are marked changes and even reversals in the trend of evolution as we follow the lines onward — of which many fairly well tested instances might be cited.

Such a reversal of trend may well be illustrated in the history of the dentition in the line leading to the Gibbons. At a very remote period, perhaps in the Lower Eocene, there was probably a marked anteroposterior crowding of the front part of the lower jaw, with a consequent elimination of one incisor and two premolars on each side, and a widening of the lower premolars, this stage being represented by *Parapithecus* and *Propliopithecus.* Subsequently there was a secondary increase of length in the front part of the rami, associated with an increase in anteroposterior diameter and a decrease in width in the lower premolars, a rapid enlargement of the canines, a widening of the distal end of the jaw and a parallel realignment of the lower tooth rows.

In brief it appears to the present writer that the genera *Parapithecus, Propliopithecus, Pliopithecus* and *Hylobates* (in the broad sense) offer a fairly good series characterized by the following changes: (a) increasing verticality of the incisors, (b) sabre-like elongation of the upper canines, (c) shortening and widening of the symphysis, (d) anteroposterior lengthening of the premolars, (e) weakening of the body of the mandible, (f) rounding of the molar crowns and of all the molar cusps.

Dryopithecus darwini *Abel.*

(Fig. 24B.)

This species, from the Upper Miocene of the Vienna Basin, is known only from the type, a third left lower molar.

From the writings and illustrations of Professor Abel (1902, p. 34) and Dr. Pilgrim (1915, pp. 15, 70) we learn that the third lower molar of this species has the following characters: both in length (13.5) and breadth (11.8) it exceeds the other European species of the genus and also *D. punjabicus*, but is considerably smaller than *D. chinjiensis* and much smaller than *D. giganteus* (length 19.1, breadth 15.3). Its breadth-index exceeds that of allied species and equals that of the Orang. The crown is low and the anterior moiety is much wider than the posterior one. The protoconid is very large and the hypoconid narrow. There is a massive external cingulum which is arranged almost precisely as in *Pliopithecus antiquus*. The enamel folds and wrinkles are more numerous and stronger than in the other European species and the deep furrows that form the characteristic *Dryopithecus* pattern fork at the ends. The inner side of the crown bears an accessory transverse furrow, as in *D. punjabicus*, *D. rhenanus* and *Homo*. The hypoconulid ("mesoconid") is placed further in toward the centre of the crown than in *D. fontani.*

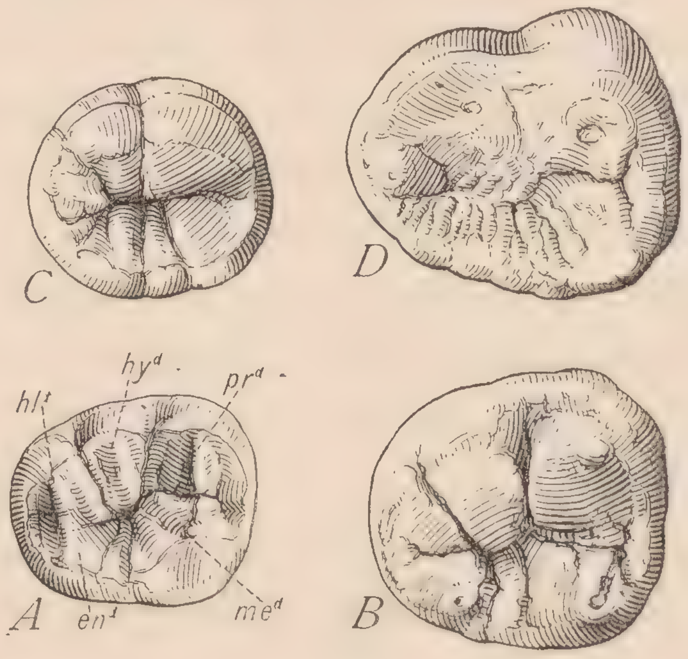

Fig. 24. Comparison of the third left lower molar of (A) *Dryopilhecus rhenanus*, (B) *D. darwini*, (C) Strandlooper Bushman, (D) Orang. All × $\frac{3}{2}$.

A and B from photographs by Abel.

Note the secondary furrows between the metaconid and the entoconid.

D. darwini is undoubtedly widely different from Abel's 2nd type of *D. fontani,* in which m_3 is elongate, with a weak cingulum and externally placed hypoconulid; but it approaches Abel's "1. Type" of *D. fontani* which is a wider tooth, with inwardly placed hypoconulid.

From *D. rhenanus* the species under consideration is distinguished by its greater breadth, more wrinkled crown, more central hypoconulid. From two of the Indian species, *D. giganteus* and *D. chinjiensis*, it is readily distinguished, but it is less distinct from *D. punjabicus*, to which it may be allied. The strong basal cingulum, as noted by Abel, seems to be a primitive character derived from *Pliopithecus*-like ancestors.

Professor Abel also notes that this tooth in its whole appearance and size, and in the arrangement and abundant branching of the furrows, approaches the men of Krapina; it differs, however, in the narrowness of the posterior moiety of the crown — a primitive character.

Dryopithecus fontani *Lartet.*

(Fig. 14B, 15B, 17D^1, D^2.)

This species is known chiefly from several lower jaws which have been figured by Lartet, Gaudry, Harlé, Smith Woodward and others. Abel (1902, p. 33) has distinguished two types of this Upper Miocene ape of France and Spain. In the first type the molars are a little wider than long, the hypoconulid is more central and posterior in position. In the second type the molars are considerably longer than broad and the hypoconulid is more external in position, almost as much as the hypoconid and protoconid. Both types have a weak basal cingulum on the front and outer sides.

The third lower molar is a little smaller than in *D. punjabicus* which, according to Pilgrim (1915, pp. 14, 15), is distinguished further by minor details such as the absence of fine wrinkles and the absence of a serrated margin on the metaconid and entoconid. From *D. chinjiensis* and *D. giganteus* the species under consideration is distinguished by its smaller size. The lower cheek teeth of *D. fontani* are of primitive anthropoid type of relatively very small size, with few wrinkles, with considerable remnants of the external cingulum and a relatively short first molar.

The jaw of *D. fontani* is of great interest on account of its relatively primitive character. The massive horizontal ramus is shorter than that of the Gorilla, which is secondarily elongated. The region of the swollen symphysis is of generalized anthropoid type, as shown in Dr. Smith Woodward's comparative cross sections (1914, p. 317). *D. fontani* is, in one sense, a collateral ancestor of the Gorilla, but perhaps not the direct ancestor, which may well be *D. chinjiensis* of India. In most characters it is intermediate between the far older *Propliopithecus* of the Fayûm and the modern Gorilla.

The varied relative lengths of the third lower molar in the anthropoids and man have led Dr. Pilgrim to exclude forms with a short m_3 from ancestral relations with those with a long m_3. The third lower molar in *Proplio-*

pithecus is relatively and absolutely short. According to Pilgrim (1915, p. 72) the ratio of length of m_3 to that of m_2 in this genus is only 96.4 as compared with 110.1 in *Pliopithecus* in which the third molar is relatively very long. In the Gibbons m_3 is extremely short (80–88); in *Dryopithecus fontani* it is relatively much longer than is *Propliopithecus,* but only slightly longer than in the Gorilla (101.2) and considerably longer than in the Chimpanzee.

Perhaps the majority of palæontologists of the present time, who believe in orthogenesis, the irreversibility of evolution and the polyphyletic origin of families, will assume that a short molar must keep on getting shorter, that it can never get longer and then again grow relatively shorter and therefore that *Propliopithecus* with its extremely short third molar and *Dryopithecus* with its long m_3 are alike excluded from the ancestry of the Gorilla, in which there is a slight retrogression in length of m_3. After many years reflection and constant study of the evolution of the vertebrates however, I conclude that "orthogenesis" should mean solely that structures and races evolve in a certain direction, or toward a certain goal, only until the direction of evolution shifts toward some other goal. I believe that the "irreversibility of evolution" means only that past changes irreversibly limit and condition future possibilities, and that, as a matter of experience, if an organ is once lost the same (homogenous) organ can never be regained, although nature is fertile in substituting imitations. But this does not mean, in my judgment, that if one tooth is smaller than its fellows it will in all cases continue to grow smaller. Frequently this is the case, but sometimes a relatively small member of a series will enjoy a secondary increase in size, or a relatively narrow structure will widen. Finally I believe that "the polyphyletic origin of families" is to some extent a contradiction in terms; for if the families are of widely diverse or convergent origin then they are not natural. On the contrary natural families perhaps usually arise from a single genus or from closely allied genera.

Hence I know no proved general principles which forbid us to believe that the last lower molar of anthropoids has always been rather variable in relative size; that it was at first small, but became larger and lengthened in *Pliopithecus* and *Dryopithecus,* becoming a little shorter in the Gorilla, much shorter in the Chimpanzee and excessively short in the Gibbon.

In the last named genus the sabre-like enlargement of the canines has thrown more work upon the masseter muscles and upon the malar bone and less upon the temporals. This may be associated with the retrogressive character of m_3. In the Gorilla, on the contrary, although the masseters are large the temporals are of enormous size and hence the third lower molar is also large. In the Chimpanzee the temporals are relatively smaller than in the Gorilla and so also is the third molar. In Man the temporals are relatively small but the whole tooth now is so short that the large masseters still exert a strong and less oblique pressure upon the third molars which are consequently still of a fair size, although the first molars, which are in the position of greatest vertical pressure, have now become dominant.

From these and similar considerations I should expect that in *Propliopithecus,* from the small size of m_3, the temporals would be relatively small, while from the vertical position of the canine and massive horizontal ramus the masseters ought to be powerful. In *Dryopithecus fontani* the temporal muscles would be only less developed than those of the Gorilla, while the massive symphysis and deep horizontal ramus indicate that the masseters also were powerful.

In conclusion I am unable to accept Dr. Pilgrim's view (*op. cit.,* pl. 4) that the Gorilla and Chimpanzee have been derived from none of the six known Indian and European species of *Dryopithecus* but trace their origin on separate parallel lines to an unknown proto-anthropoid stock that lived somewhere far back in the Lower Miocene. Such a view may possibly prove to be true; but before assuming it, what characters definitely exclude *D. chinjiensis, D. punjabicus* and *D. fontani* from at least very close kinship with the true ancestors of both the Gorilla and the Chimpanzee? While differences between the Miocene and modern genera are striking, my difficulty in fact is to find provedly aberrant characters which will definitely and positively exclude these forms from such ancestry. According to Dr. Pilgrim the cleft between Gorilla and Chimpanzee is so great that the latter is very widely removed from the known species of *Dryopithecus* in the Upper Miocene in India. But to me after comparing repeatedly the Indian types with the Gorilla and Chimpanzee the evidences at least of close kinship are of the most convincing character. According to this view the European *D. fontani* may even be directly intermediate between the Asiatic types on the one hand and the modern African Gorilla on the other; while the allied *D. rhenanus* may stand nearer to the direct ancestors of the Chimpanzee.

Dryopithecus rhenanus (*Pohlig*).

(Part I, Figs. 12D, 15B; Part II, Figs. 21A, 24A, 25C, 26B).

While *D. fontani* is of Upper Miocene age *D. rhenanus* comes from the Lower Pliocene (Swabian Bohnerz). It is represented chiefly by two upper molars and a number of lower molars, from the Swabian Alps, which have been very carefully figured by Branco (1898, Taf. I, II). According to Abel (1902, p. 2) the real type of the species is a femur from the sands of

Eppelsheim, described by Pohlig (1895) as *Paidopithex rhenanus* and by Dubois (1897) as *Pliohylobates eppelsheimensis.* These were later referred by Schlosser (1902), along with the upper and lower molars, to the genus *Dryopithecus.* Abel defines the species as follows: Molars longer than broad (except the lower m_1), the hypoconulid placed well in toward the centre. Basal cingulum as a rule not present, except on the last lower deciduous molar.

The trigonid basin is represented by a transversely oval pit at the front end of the crown, while a similar pit at the hinder end lies between the remnant of the posterior cingulum and the ridge connecting the entoconid and the hypoconulid. This ridge is quite prominent in this species and in *D. giganteus* but not in other species.

The upper molars are quadritubercular with strong folds and wrinkles.

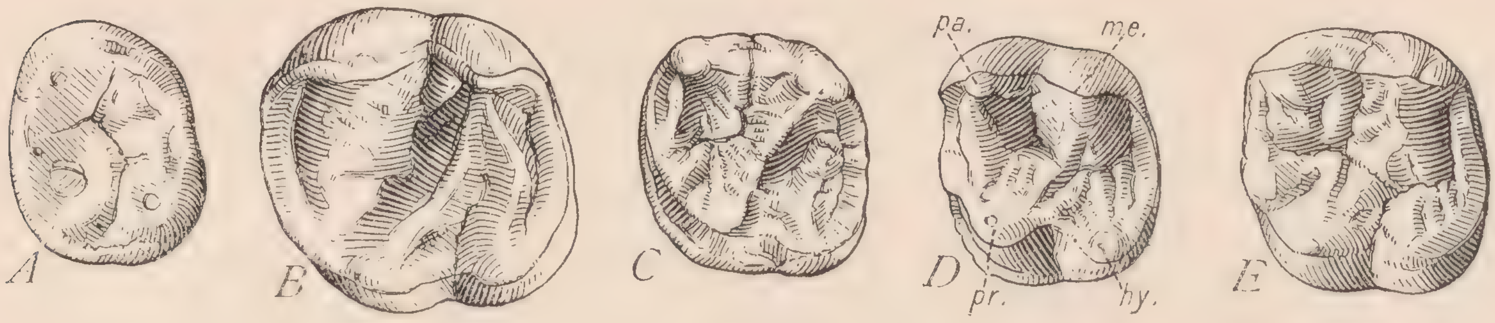

Fig. 25. **Comparison of left upper molars.**
A. *Griphopithecus suessi*, m^3. **After Abel.**
B. *Dryopithecus punjabicus*, m^1. **After Pilgrim.**
C. *Dryopithecus rhenanus*, m^1. **From a cast of a specimen figured by Branco.**
D. Chimpanzee, m^1. A. M. N. H. No. 35550.
E. Orang, m^1. A. M. N. H. No. 35549.

They are distinguished from the upper molars referred to *Dryopithecus punjabicus* by the following characters observed by Pilgrim (1915, p. 20). In the Indian species, "the breadth index of the molars is greater. The cusps are probably lower. The outer cingulum is less clear. . . . The furrows on the outer cusps cross the edge of the tooth, and so produce in side view a serrated appearance, which appears to be absent from *Dryopithecus rhenanus.*" The patterns of both the upper and the lower molars of *Dryopithecus rhenanus* approach those of the Chimpanzee in many characters, except that in the latter the molar crowns are more rounded, less quadrangular and the third molars are often rounded and more degenerate in form. *D. rhenanus* may therefore represent a closely related if not directly ancestral phylum leading to the Pleistocene and Recent Chimpanzees.

Neopithecus.

Neopithecus brancoi (Schlosser), Abel.

Anthropodus brancoi Schlosser.

(Fig. 26A.)

Dr. Schlosser (1902, p. 266) suggests that the age of this specimen may possibly be Upper Pliocene. This genus and species is represented by a third lower molar from the Swabian Bohnerz. It is smaller than any species of *Dryopithecus* and is distinguished from all other anthropoids by its narrowness, the breadth index being only 75.7, while in *Dryopithecus* the index ranges from 80.1 to 87.4 (Pilgrim). Gaudry suggested that it was a last lower milk molar but this view was vigorously combatted by Schlosser (1901, p. 262), who states that a milk molar may always be recognized by its strongly divergent roots which afford space for the replacing tooth beneath it, and by its thin enamel, the opposite characters being shown in the molar under consideration. Schlosser notes that this tooth has the characters of a permanent m_3, that the posterior root is compressed and prolonged backward, while the median posterior cusp (hypoconulid) is unusually large and forms a third lobe. In the living anthropoids and in man this strong development of the posterior cusp of m_3 is no longer evident, but as it is found in almost all of the more ancient mammals and is present in *Pliopithecus,* the ancestor of the Gibbon, its presence in a fossil anthropoid, says Schlosser, is not surprising.

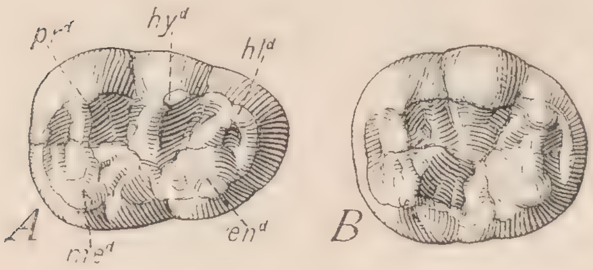

Fig. 26. A. Third lower molar of *Neopithecus* (*Anthropodus*) *brancoi* Schlosser. × $\frac{3}{2}$. Drawn from a reversed image of a cast of the type, which is a third left lower molar.

B. Third right lower molar of *Dryopithecus rhenanus.* × $\frac{3}{2}$. From a cast of a specimen figured by Branco.

Under the name *Anthropodus* (which, as noted by Abel, was preöccupied by *Anthropodus* De Lapouge) Dr. Schlosser gave the following generic definition:

Anthropodus n. g. Only lower m_3 known, much longer than broad, without basal cingulum, consisting of five principal cusps, whereof the first inner cusp (metaconid) is higher and larger than the remaining second inner cusp (entoconid). Second outer cusp (hypoconid) and posterior cusp ("mesoconid") alternating; first outer cusp (protoconid) standing only a little further back than the first inner cusp (metaconid). Secondary intermediate cusps present behind metaconid and between entoconid and mesoconid. Cusps provided with enamel grooves running toward the midline — one for each cusp except the metaconid which has three grooves. Peculiar topography (Sonstiges Relief): furrows and grooves weakly developed. Posterior root of m_3, as a result of the talonid-like extension of m_3, strongly extended posteriorly.

As specific characters Dr. Schlosser gives the dimensions of m_3 (length 10.3, greatest breadth 7.8, height of the metaconid 5.3) and the estimated measurement of the three lower molars (35 mm.) and of the premolars and molars (46.–48. mm.).

From the corresponding molars of *Dryopithecus* that of the present genus, continues Dr. Schlosser, is distinguished by its relatively slight breadth, by the relative lowness of the several cusps, by the strong development of the mesoconid, by the weakness of the enamel wrinkles and above all by the weak relief of its grinding surface; although the course of the principal enamel furrows is essentially the same in the two genera. At first sight it is much like a human tooth, but the latter is very much shorter and wider, with more massive higher cusps, and consequently deeper insinking of the middle of the crown; finally the enamel furrows and grooves in man are decidedly coarser and the whole relief of the crown somewhat more complicated and irregular. In all these details, except the less strongly developed cusps, *Anthropodus* is more primitive than either *Dryopithecus* or *Homo*. The origin of *Anthopodus* continues Schlosser (p. 267) is still obscure; the only certainty is that it is nearly related to *Dryopithecus*. It differs from *Pliopithecus* in the more complicated pattern of the crown through the appearance of enamel foldings and also in the disappearance of the basal cingulum; it is, however, more primitive than *Pliopithecus* in the posterior elongation of m_3.

To the writer the type m_3 of the species under consideration presents an underlying resemblance to a certain m_3 of *Dryopithecus rhenanus* of which a photograph is given by Abel (1902, Pl., fig. 4), except that in *Neopithecus* the enamel is covered with coarse grooves, the tooth as a whole is elongate, narrow and the posterior pit is filled up. But, in spite of all efforts, the more precise relationship of *Neopithecus* remains obscure. It may well be a late descendant of some primitive species of *Dryopithecus* that still retained an elongate narrow m_3. The enamel folds and wrinkles seem to have been acquired independently in all phyla of the man-anthropoid series.

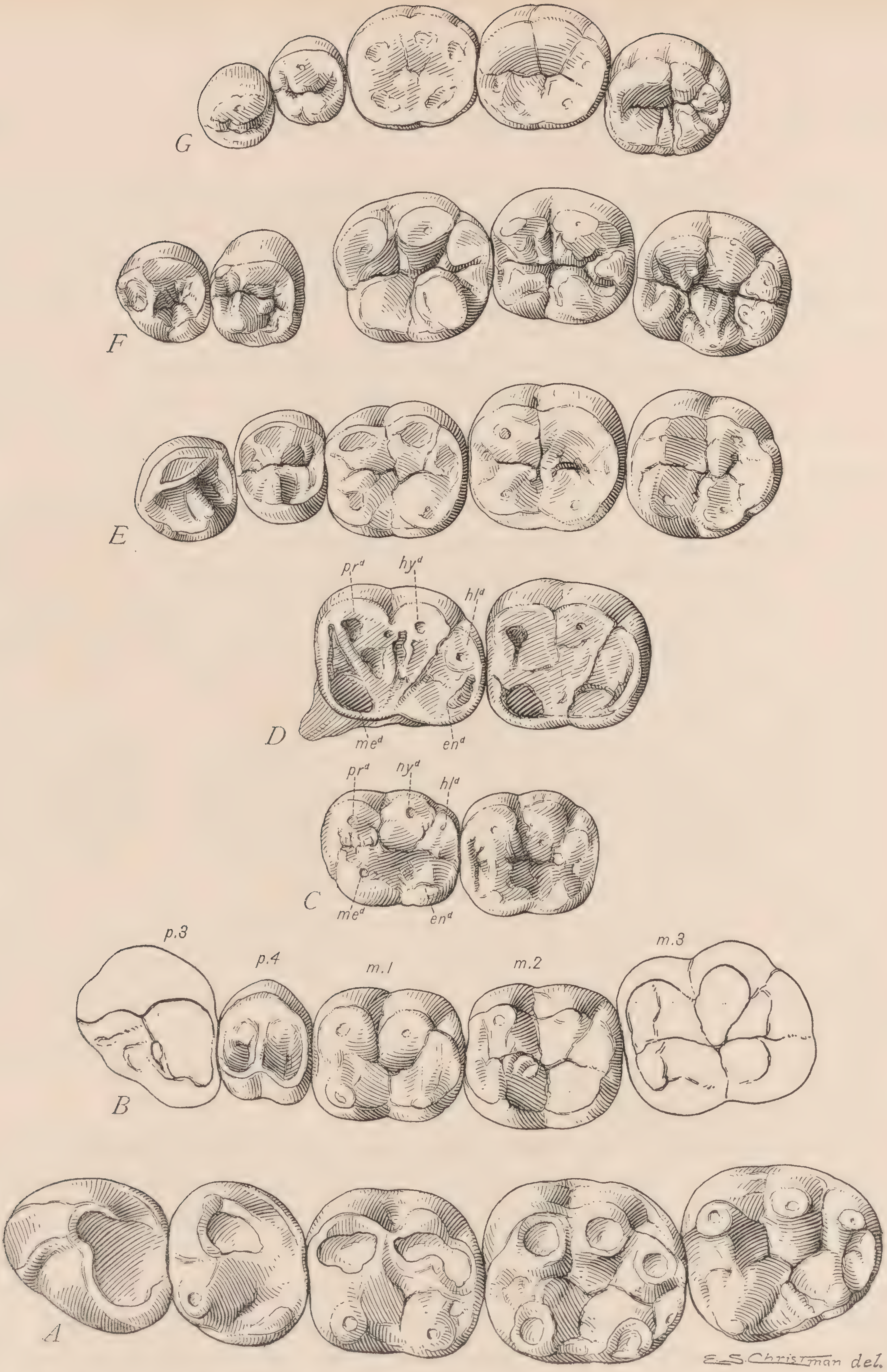

Fig. 27. Right lower premolar-molar series of primitive men and of anthropoids. Crown views. × *circa* $\frac{3}{2}$.

A. *Gorilla* sp.
B. *Sivapithecus indicus.* After Pilgrim.
C. *Pan* sp. Much worn molars of an old chimpanzee. After Miller.
D. *Pan vetus.* Much worn molars of the Piltdown mandible; from a photograph published by Smith Woodward (× $\frac{3}{2}$ +).
E. *Homo heidelbergensis.* From a photograph published by Schoetensack.
F. *Homo sapiens.* Molars of an old female Australian black. Premolars of a male negro.
G. *Homo sapiens.* Lower premolar-molar series of a Strandlooper Bushman (Gift of Dr. R. Broom).

From this series it appears that Mr. Miller is well warranted in stating that the Piltdown molars are generically referable to *Pan* rather than to *Homo*.

Anthropopithecus (Pan).

Pan vetus *Miller.*

(Figs. 27D, 28, 29B, 30B, 31B, 32A, 33A).

In an earlier paper (1914) I have reviewed the controversy over the Piltdown remains (*Eoanthropus dawsoni*), emphasizing the entirely human character of the brain-case, the essentially ape-like character of the lower jaw and teeth and the doubts as to their association already expressed by several authors. With some doubts, which were even more strongly felt by my colleague Dr. Matthew, I was led to accept provisionally the association of the jaw with the skull, chiefly because the jaw is stated to have been found within a yard of the point where a piece of the occiput was discovered, and at precisely the same level. In this connection I said (op. cit., p. 194) that: "Fossil remains of anthropoids of any age have hitherto been exceedingly rare, and the chances that a jaw of a hitherto unknown type of ape should be washed into the same gravel bed with a human skull of conformable size, and that both should become mineralized in the same manner and degree, may be regarded as extremely small." The chances of such a coincidence occurring were, no doubt, extremely small, but nevertheless the event must have happened, for I consider that Mr. Gerrit S. Miller (1915) has practically demonstrated that the Piltdown lower jaw

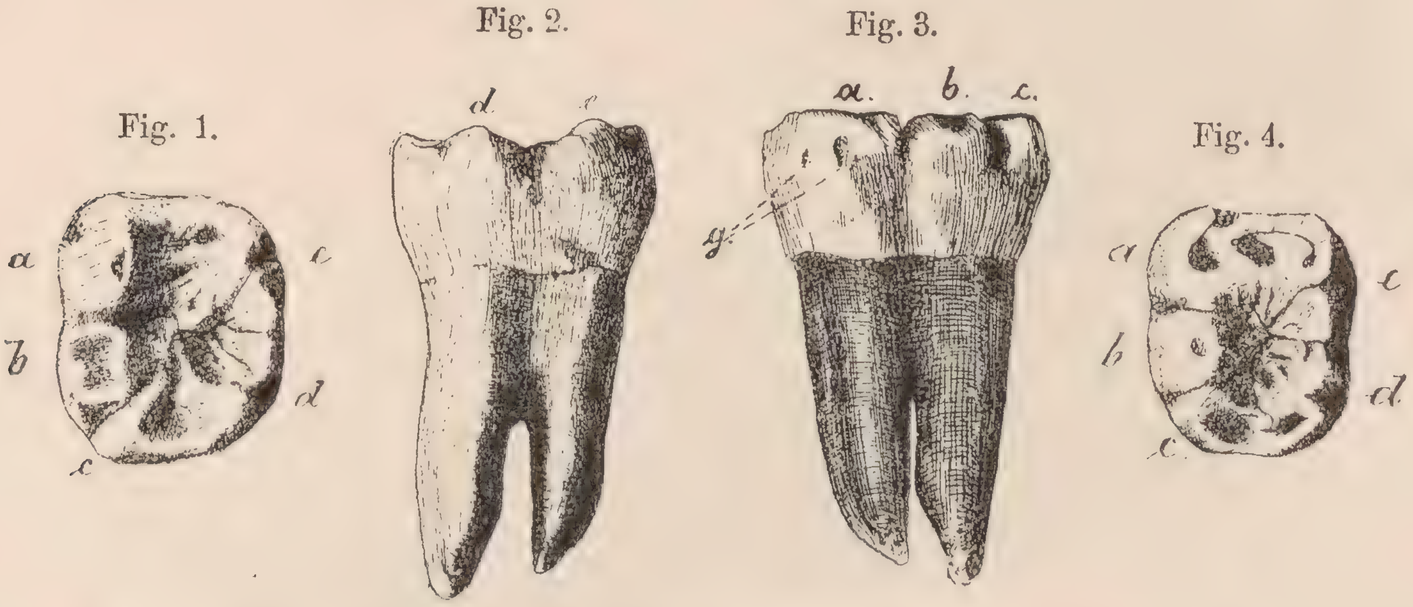

Fig. 28. Three views of first left lower molar figured by Nehring in 1895 as a human tooth, from the diluvium at Taubach near Weimar, together with a crown view (Fig. 4) of the corresponding tooth of a chimpanzee. All after Nehring. About $\frac{3}{2}$ nat. size. Fig. 1 crown view, Fig. 2 lingual side, Fig. 3 labial side.

Mr. Miller remarks that this tooth resembles the first lower molar of the Piltdown mandible and likewise represents a Pleistocene species of chimpanzee. Nehring himself noted its strong resemblance to a chimpanzee molar, but in spite of that referred it to *Homo*.

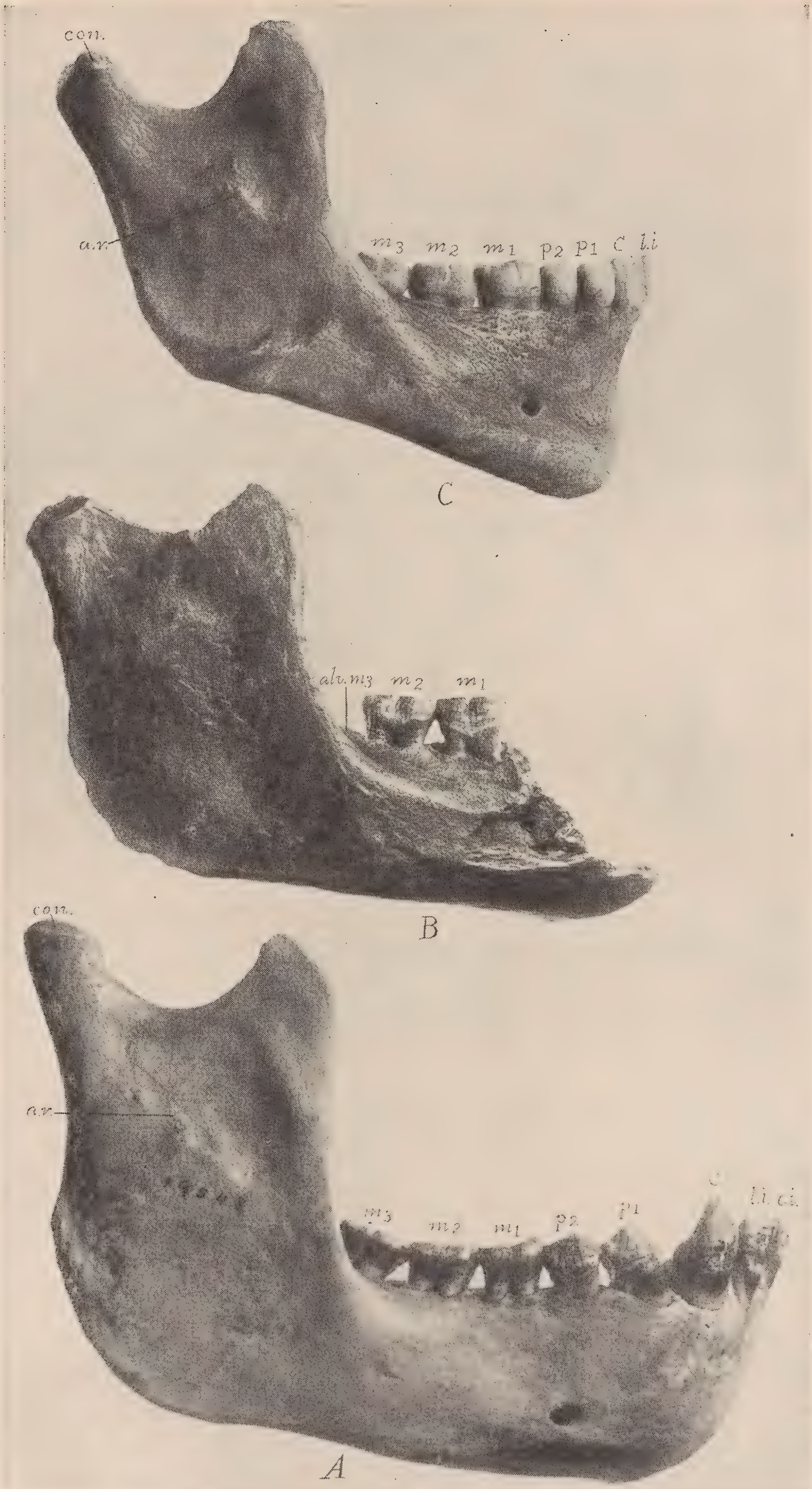
con.
a.r.
m_3 m_2 m_1 p_2 p_1 c l.i.
C
alv. m_3 m_2 m_1
B
con.
a.r.
m_3 m_2 m_1 p_2 p_1 c l.i. c.i.
A

Fig. 29. The Piltdown lower jaw (B) from a cast in the Williams Collection, compared with a female orang (A) and a modern man (negro) (C). External views. × $\frac{3}{4}$. *alv.* m_3, socket for third lower molar; *a.r.*, ascending ramus; *c*, canine; *c. i.*, central incisor; *con.*, condyle; *l. i.*, lateral incisor; m_1, m_2, m_3, molars; p_1, p_2, first and second premolars (equivalent to p_3 and p_4 of lower mammals). After W. K. Gregory (1914).

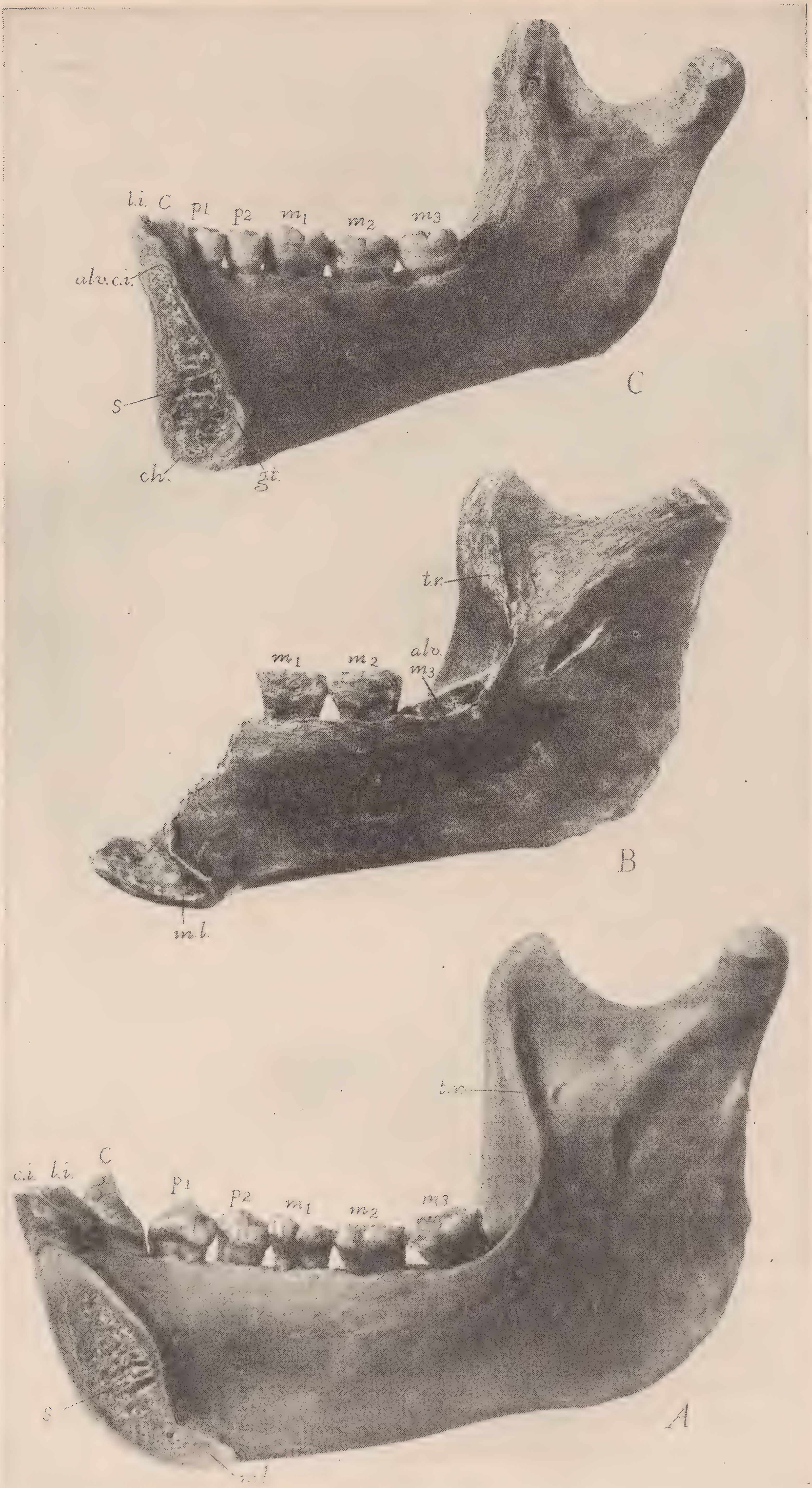

Fig. 30. Lower jaw of the Piltdown man (B), of a female orang (C) and of a modern negro (A). Inner side. × $\frac{3}{4}$. *alv. c. i.*, alveolus for central incisor; *ch.*, bony chin; *g. t.*, genial tubercle; *m. l.*, mental ledge; *t. r.*, ridge in area of temporal muscle; *s*, section through symphysis. (*op. cit.*, 1914.)

represents a Pleistocene species of Chimpanzee and that it did not belong with the associated brain-case (see also Appendix B, below, p. 348).

In all views of the jaw — from beneath, from above, from the inner side and from the outer side — it is generically identical with the aged specimens of *Pan* figured by Miller. Every curve and contour in these chimpanzees is followed with minor variations in the Pleistocene jaw. Dr. Woodward's own comparative figures (1914, p. 317) of the symphysial region of *Eoanthropus* and other anthropoids, as well as his later figures (1915, pp. 16–21) of three views of the jaw, all show how close this jaw is to that of a female chimpanzee and how widely different it is from that of *Homo heidelbergensis.* And not one of the characters of the jaw and teeth, as most ably analysed by Professor Keith (1915, pp. 430–478) establish a generic difference from the chimpanzee.

The two molar teeth although greatly worn show the primitive *Dryopithecus* pattern, which is disguised in all the Hominidæ; the molars appear to agree generically with those of the very old female chimpanzees figured by Miller (*op. cit.*, pl. 2, figs. 2″, 1″, 4). They differ from all human molars that I have seen in being relatively long and narrow and in having the posterior moiety less widened transversely. From the molars of *Homo heidelbergensis* they differ in the same characters, although in somewhat less degree. Also the long axis of m_1 in *Pan vetus* is continuous with that of m_2 as it is in *Dryopithecus, Sivapithecus* and all other apes, while in man (including *H. heidelbergensis*) m_1 is a large, wide, well-rounded tooth, which is displaced internally and has its long axis turned more or less inward at the front end, in conformity with the inward sweep of the mandible.

The completely human character of the glenoid region (Fig. 33) and the complete absence of simian features both in this region and in the region of the temporal muscle area offered an insuperable difficulty, as long as one accepted the supposed association of the jaw with the skull. By all well-founded analogies a true link between the Simiidæ and Hominidæ should have more intermediate characters in both jaw and temporal region; but, as fully expounded by Mr. Miller (*op. cit.*, pp. 14–18), the whole conformation of this region in the Piltdown skull demands a human or subhuman lower jaw, while the anthropoid jaw demands anthropoid glenoid and temporal regions.

Now that this anomalous composite called *Eoanthropus* has been resolved into its diverse elements we realize again that the transformation of the Simiidæ into the Hominidæ took place at a much earlier period; and that the entirely human dentition of *Homo heidelbergensis* shows that this transformation was effected long before the Mid-Pleistocene; a view which has been strongly urged by Professor Keith, but upon other grounds.

If the Piltdown skull, which is entirely human, bore a human jaw, as now seems likely, then there is no necessity for pushing the point of divergence of *Eoanthropus* and *Homo* far back into the Lower Pliocene, as in Professor Keith's diagram (1915, p. 509).

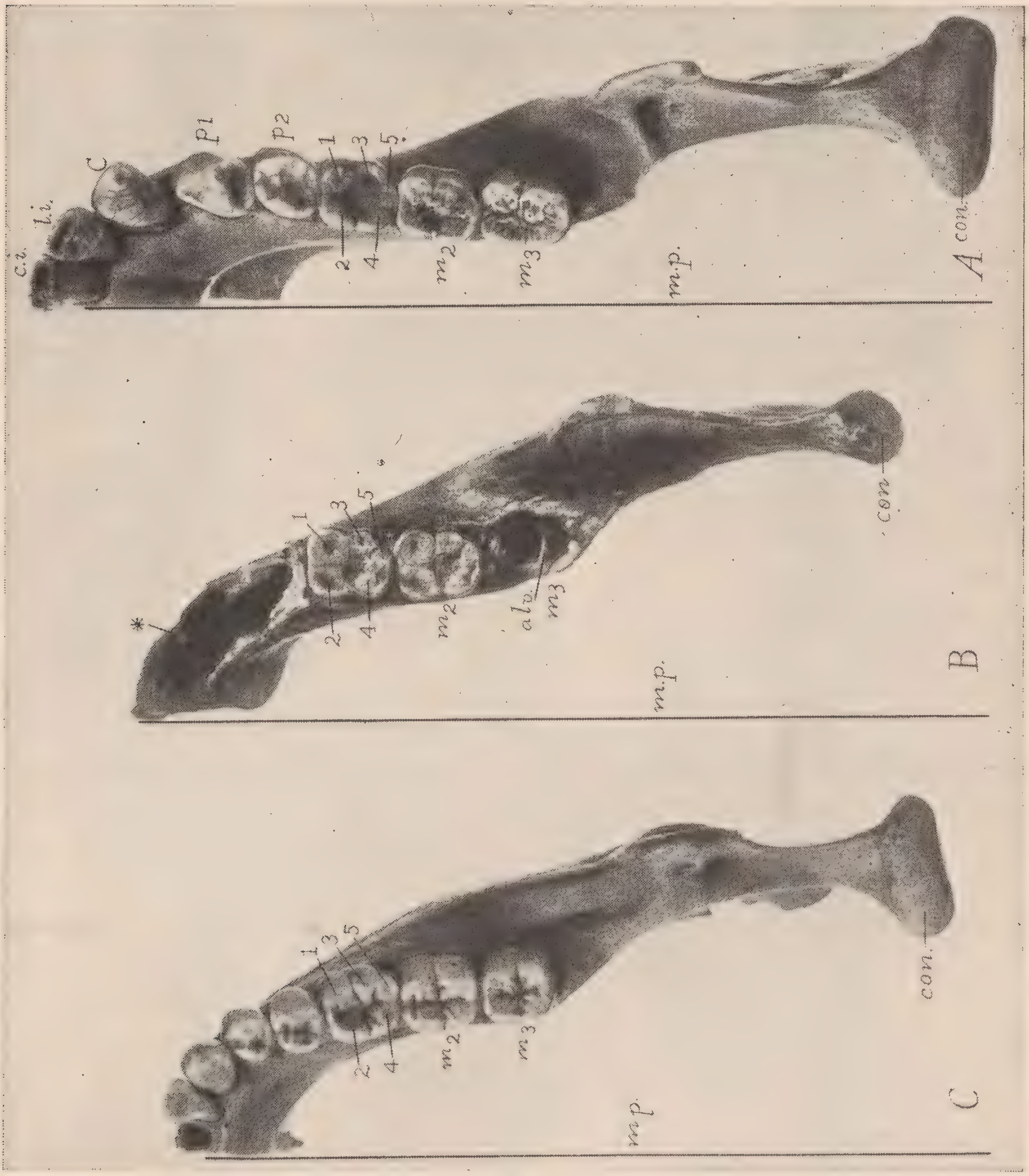

Fig. 31. The same three specimens of Figs. 29 and 30, viewed from above. (*op. cit.*, 1914.) *1, 2, 3, 4, 5*, cusps of the lower molars; *m. p.*, median plane; *, broken edge.
In A and B the median plane (*mp.*) is incorrectly placed. It should be further away from the condyle in A and somewhat nearer to the condyle in B.

The persistence of one of the great apes in the Pleistocene of Europe, as a survivor of the *Dryopithecus* group of the Upper Miocene and Pliocene, is analogous with the persistence in the same region of hippopotamus and

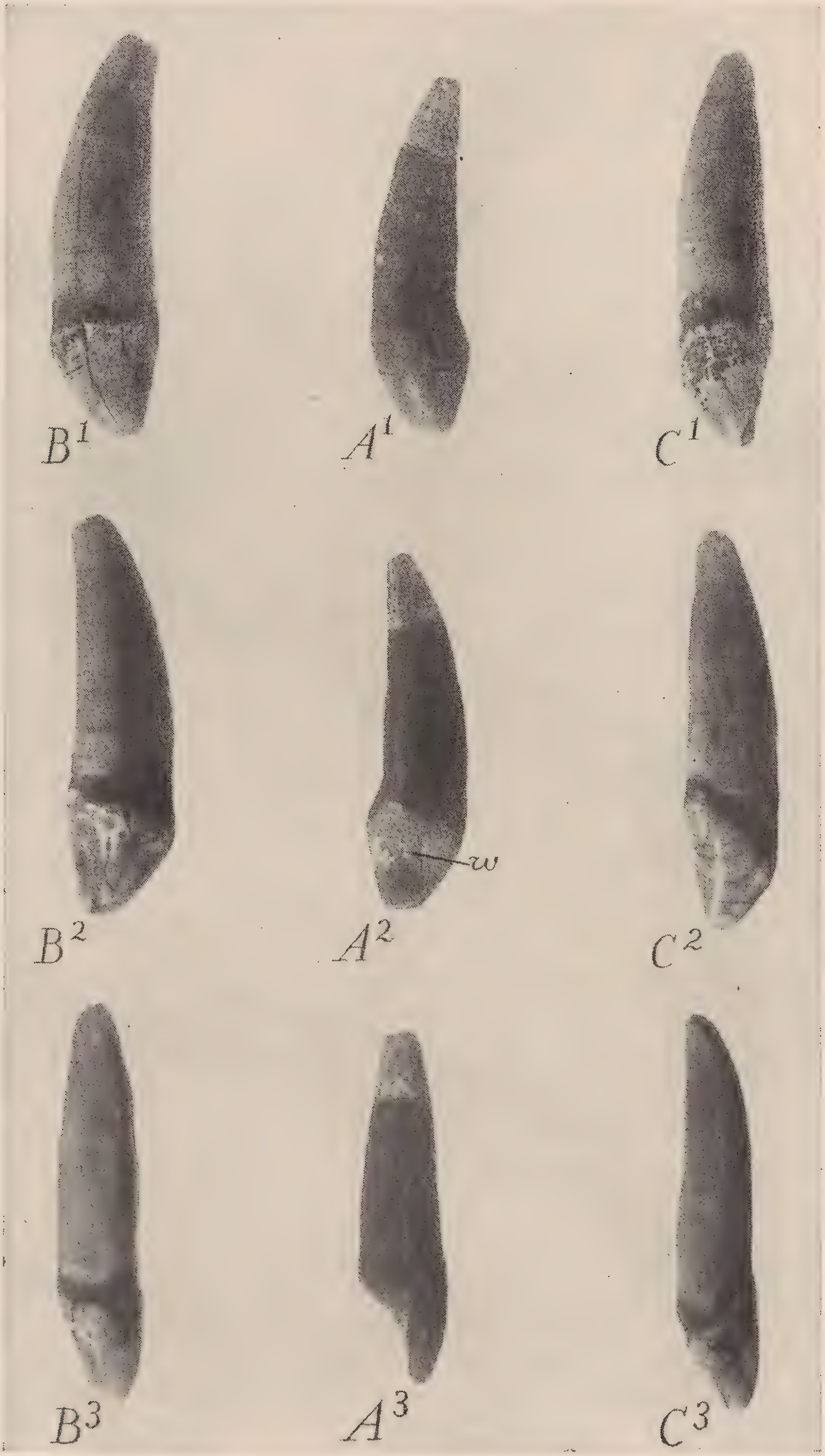

Fig. 32. Canine tooth (cast) of the Piltdown man (A) in comparison with the left upper (B) and right lower (C) canines of a female orang. $\times \frac{1}{1}$. The lower canine is turned upside down to facilitate comparison with the others. In A the tip of the root is restored. (*op. cit.*, 1914.)

A^1, B^1, C^1. Seen from the outer or labial side.
A^2, B^2, C^2. Seen from the inner or lingual side. *w*, worn surface.
A^3, B^3, C^3. Seen from the front, or antero-internally.

other forms at present confined to the tropics. The fact that the Pleistocene species is distinguished from the modern type by a somewhat more robust mandible and larger molar teeth also finds precedents among other mammalian phyla.

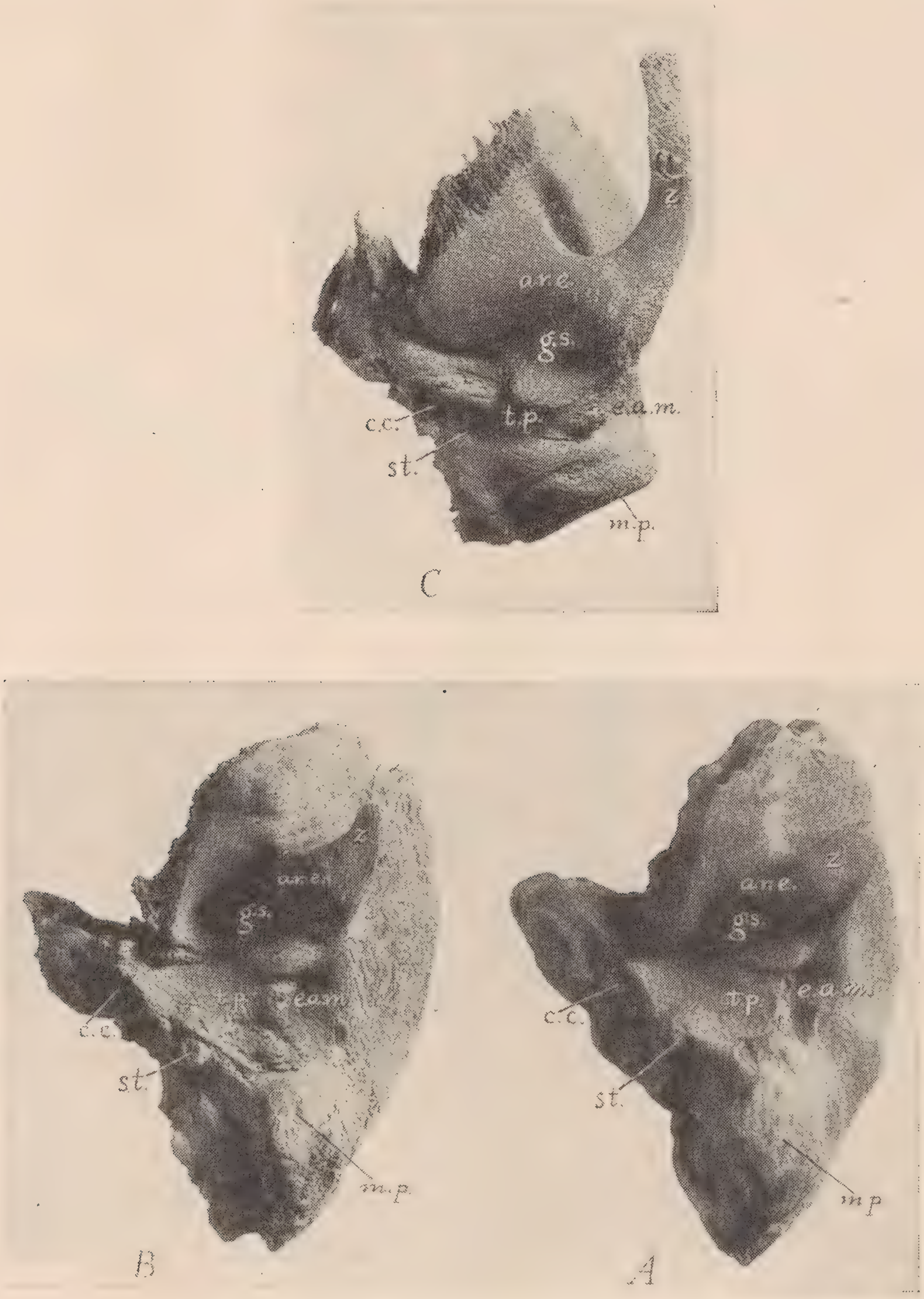

Fig. 33. Temporal bones of the Piltdown man (A), of a negro (B) and of a female orang-utan (C) Two-thirds natural size. (*op. cit.*, 1914.)

ar. e., articular eminence (for lower jaw); *c. c.*, carotid canal; *e. a.m.*, opening leading to middle ear; *g. s.*, glenoid socket (for lower jaw); *pet.*, bone surrounding internal ear; *st.*, pit for styloid process; *t. p.*, tympanic plate; *z*, root of zygomatic arch.

As to the canine tooth, in my earlier paper I recorded the observation of Mr. A. E. Anderson, that this tooth agreed better with the left upper canine of apes than with the right lower one, as originally identified by Dr.

Smith Woodward. I was at that time not entirely convinced of this identification, but its correctness seems to have been confirmed by Mr. Miller (p. 12) who finds left upper canines of aged female chimpanzees which closely approximate the Piltdown canine both in form and in the manner of wearing down. I also consider the resemblances to the right lower milk-canine of man, noted by Dr. Woodward (1915, p. 22, Fig. 9), as not being sufficiently close to be demonstrative of homology.

Pithecanthropus erectus *Dubois.*

(Fig. 34 C^1, C^2.)

The molars referred by Dubois to *Pithecanthropus* are remarkable for their extraordinary size, for the widely divergent roots, and for the similarity of the contour of the crown to that of an Orang (B). The contour is certainly nearer to that of the Orang and *Dryopithecus* than to the human types. The possibility is that *Pithecanthropus* may be related both to *Homo* and to *Sivapithecus.*

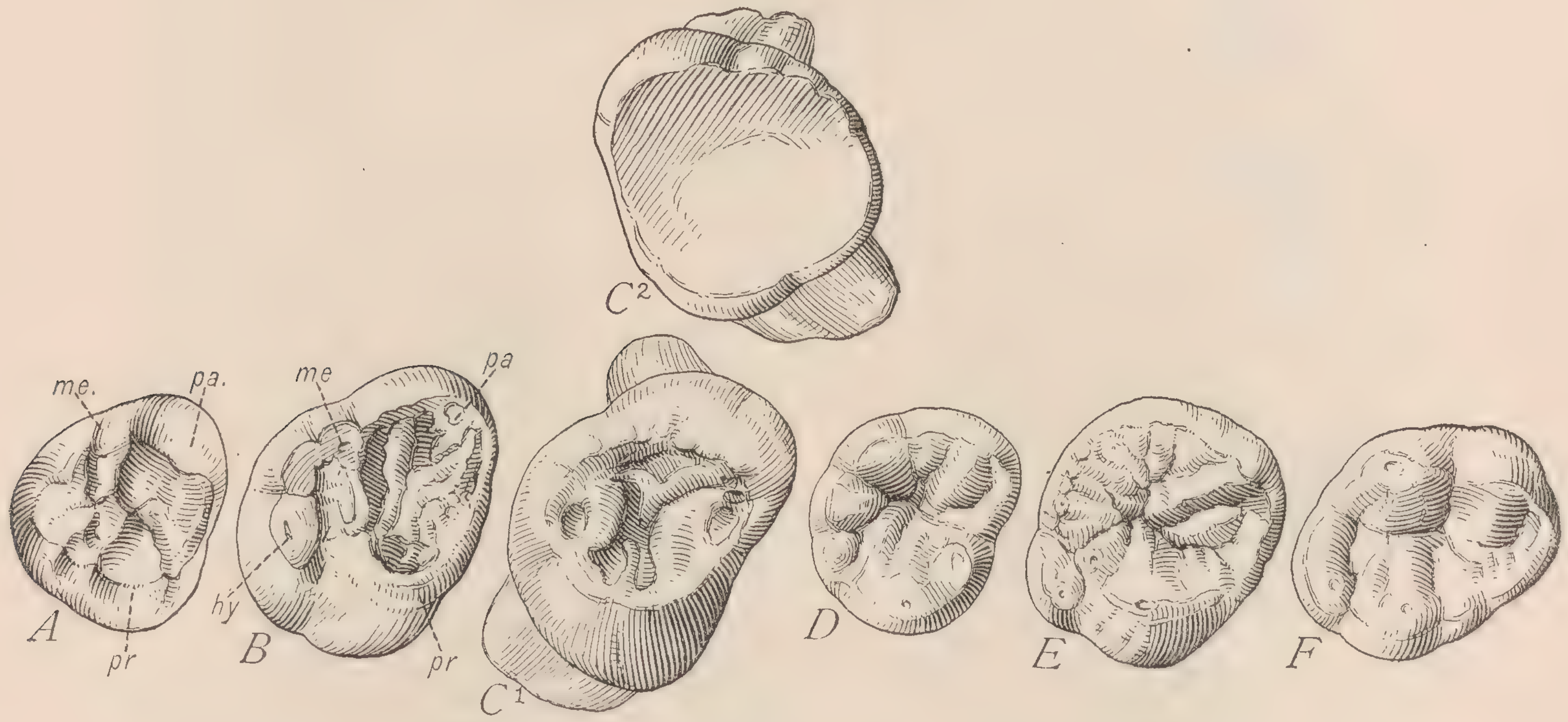

Fig. 34. Third right upper molar referred by Dubois to *Pithecanthropus* (C) in comparison with various human and anthropoid types. All figures $\times \frac{3}{2}$.

- A. *Dryopithecus punjabicus*, referred specimen. After Pilgrim.
- B. Modern Orang.
- C^1. *Pithecanthropus erectus.* Cast of referred specimen (m^3 right).
- C^2. *Pithecanthropus erectus.* Cast of a second referred specimen (m^3 left).
- D. *Homo sapiens.* Australian black (♀).
- E. *Homo sapiens.* Kaffir.
- F. *Homo sapiens.* Brachycephalic Caucasian.

Homo.

Homo heidelbergensis *Schoetensack.*

(Fig. 27E.)

The jaws and dentitions of all known anthropoids appear to be adapted for a chiefly frugivorous diet; and they have protruding canines, gently procumbent incisors, and more or less parallel tooth rows. On the other hand the jaw and dentition of *Homo heidelbergensis* appear to be adapted for an omnivorous diet; its canines are small and do not protrude above the level of the adjoining teeth and its opposite tooth rows form an arch in the human fashion. Moreover the form and crown pattern of every tooth is distinctly human, and it is chiefly the lack of a chin, the restricted space for the tongue, the great depth of the horizontal ramus and the great width of the ascending ramus that recall the ancestral anthropoid characters. From the typically human character of the dentition of *Homo heidelbergensis* and from its relatively great antiquity as compared with other human remains we learn that the transition from anthropoid to human characters in the dentition took place at an epoch far anterior to the Mid-Pleistocene.

The sharply worn tips of the vertically placed incisors indicate an "edge-to-edge bite" of the upper and lower incisors which would be well fitted for pulling and tearing meat from bones. The stout premolars and molars and enormous jaws would be well able to chew the meat and crack the bones. If it be objected that a carnivorous animal should have large canines it may be replied that the human manner of killing the food and of eating it is wholly different from that of quadrupedal carnivores. The canines of the anthropoids were, I believe, evolved for a frugivorous diet and secondarily may be of some value as fighting weapons; but when the ancestors of man came down from the trees and took up a cursorial and predatory life, using weapons instead of teeth in fighting, the canines were shortened as the face and dental arch were retracted, and the short vertical canines and stout bicuspids proved just as effective in piercing bones as the large canines and premolars had been in piercing the tough rinds of fruits. The work of the canines and incisors may also have been made easier by the use of flints for cutting the food (see below p. 325).

While the dentition of *H. heidelbergensis* is distinctly human, the photographs published by Dr. Schoetensack and the casts of the type reveal certain slightly primitive characters. In the first place the dental arch is not so convex and the divergence of the opposite rami is not so great as it is in brachycephalic human skulls, although greater than in many dolichocephalic skulls. Consequently the premolars are not so much crowded inward, with reference to the first molar. Secondly, the patterns of the premolar crown retain clearer traces of derivation from a *Sivapithecus*-like type (Fig. 1), and the premolars are relatively larger in size than in most modern jaws. Thirdly, although the molars show the well rounded wide human character, with large hypo- and entoconids and the human modification of the "*Dryopithecus*" pattern of the furrows which make a + in the middle of the crowns, they are all less widened than in many modern skulls; m_1 is not larger than m_2, m_1 retains more of the "*Dryopithecus*" pattern, all the molars retain the hypoconulid and m_3 has the hypoconulid projecting backward. Finally, while the jaw itself is of gigantic size the teeth are actually smaller than in certain Australian and Kaffir jaws. In other words the dentition of *Homo heidelbergensis* differs from that of *H. sapiens* only in retaining certain primitive characters which are frequently lost in the higher types. The mandible itself also differs from the higher type solely in its greater size and numerous more primitive characters.

Hence I recognize no character in this species which would definitely exclude it from ancestry to *H. sapiens* and as it differs from the later type and also from *H. neanderthalensis* only in its more primitive characters and far greater geological age I see no reason for regarding it as an aberrant side line.[1]

The gigantic size of *H. heidelbergensis* might be cited as a specialization that would exclude this species from the direct line leading to *H. sapiens,* on the ground that in many other phyla of mammals the gigantic members are supposed not to be ancestral to the smaller existing races. But, however, it may have been in other phyla, a large stature, or more precisely a massive head and thorax, may well be expected in the ancestral Hominidæ. When the ape-men definitely abandoned the forests and intruded themselves into the gigantic and well-armed fauna of the plains we may be sure there was no place for undersized gibbon-like beings of pacific habits, but all the conditions at first favored the evolution of powerful and aggressive hunters and fighters, killing with the crudest weapons and tearing off the raw meat with their powerful jaws. As the jaw of the Heidelberg Man is lower in type than that of the Neanderthals it seems likely that his intelligence was also of a lower order, the face extremely heavy, and the forehead retreating, a conception well worked out in Professor Rutot's restoration. The total absence of palæoliths or other artifacts (aside from the highly questionable "eoliths") until the Pre-Chellean epoch also suggests that the earlier races were much less intelligent than the Neanderthals, who knew how to make a number of kinds of stone implements. Finally, as the teeth are at least generically identical with those of *H. sapiens,* I see no good evidence either for regarding the Heidelberg race as a distinct genus or for pushing far back into the Lower Pliocene the supposed point of divergence between the lines leading to *H. heidelbergensis* and *H. sapiens,* as in Professor Keith's diagram (1915, p. 501).

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[1] The significance of the "taurodont" character of the roots of the molar teeth is discussed below (p. 325).

Homo dawsoni (*Smith Woodward*).

Eoanthropus dawsoni Smith Woodward.

Mr. Miller ((1915), p. 4) suggests that "A mandible as heavy as that of the Pleistocene *Homo heidelbergensis* would probably be in due proportion" with the massive brain-case of the Piltdown race. Since Mr. Miller has also adduced strong reasons for believing that the Piltdown skull bore a human jaw and not a chimpanzee jaw, the possibility of referring the human Piltdown remains to *H. heidelbergensis* must be considered, especially as the precise age of the Piltdown remains has never been positively settled.

In 1914, when studying the fragments of the Piltdown brain-case I was impressed by the fact that they offered no salient distinctions from *H. sapiens,* the most remarkable feature being their great thickness. Even the pattern of the meningeal vessels impressed upon the cerebral surface of the parietal is similar to that of some human skulls. Similarly, in the lower teeth of *H. heidelbergensis,* the only differences from *H. sapiens* appear to be primitive characters.

The affinity of the Piltdown skull with the Heidelberg jaw, if it ever be established, will go far toward clearing up the origin of *H. sapiens,* a species which is now left without known ancestors in the most recent phylogenies (*cf.* Keith, 1915, p. 501; Osborn, 1915, p. 491). But as such affinity is so far only suspected, and as the evidence for referring the Piltdown skull to *H. sapiens* is also incomplete, it may be left provisionally in a third species *Homo dawsoni* (Smith Woodward).

Homo neanderthalensis.

(Fig. 35B).

Professor Adolff (1907) has pointed out that the Neanderthal molars differ widely from those of *H. sapiens.* The pulp cavity is very large and extends far down the interior of the tooth, limiting the fangs proper to the lower end of the tooth. The roots are not sharply constricted from the crowns but form with the crowns a stout column, tapering gently toward the bottom and extending deeply into the jaw and adapted to a sweeping motion of the jaw. To designate this somewhat ox-like character of the Neanderthal molars Professor Keith (1913) invented the term "taurodont" in contradistinction to the "cynodont" molars of *H. sapiens* which have a small pulp cavity and long separate fangs. This peculiar adaptation, which is seen in an incipient stage in *H. heidelbergensis*, is unlike anything known in the anthropoids and supports the suggestion (p. 277 above) that there was a very early and marked change in diet in the forerunners of man. Professor Keith (1915, p. 151) interprets the adaptive significance of this taurodont character of the Neanderthal molars as follows:

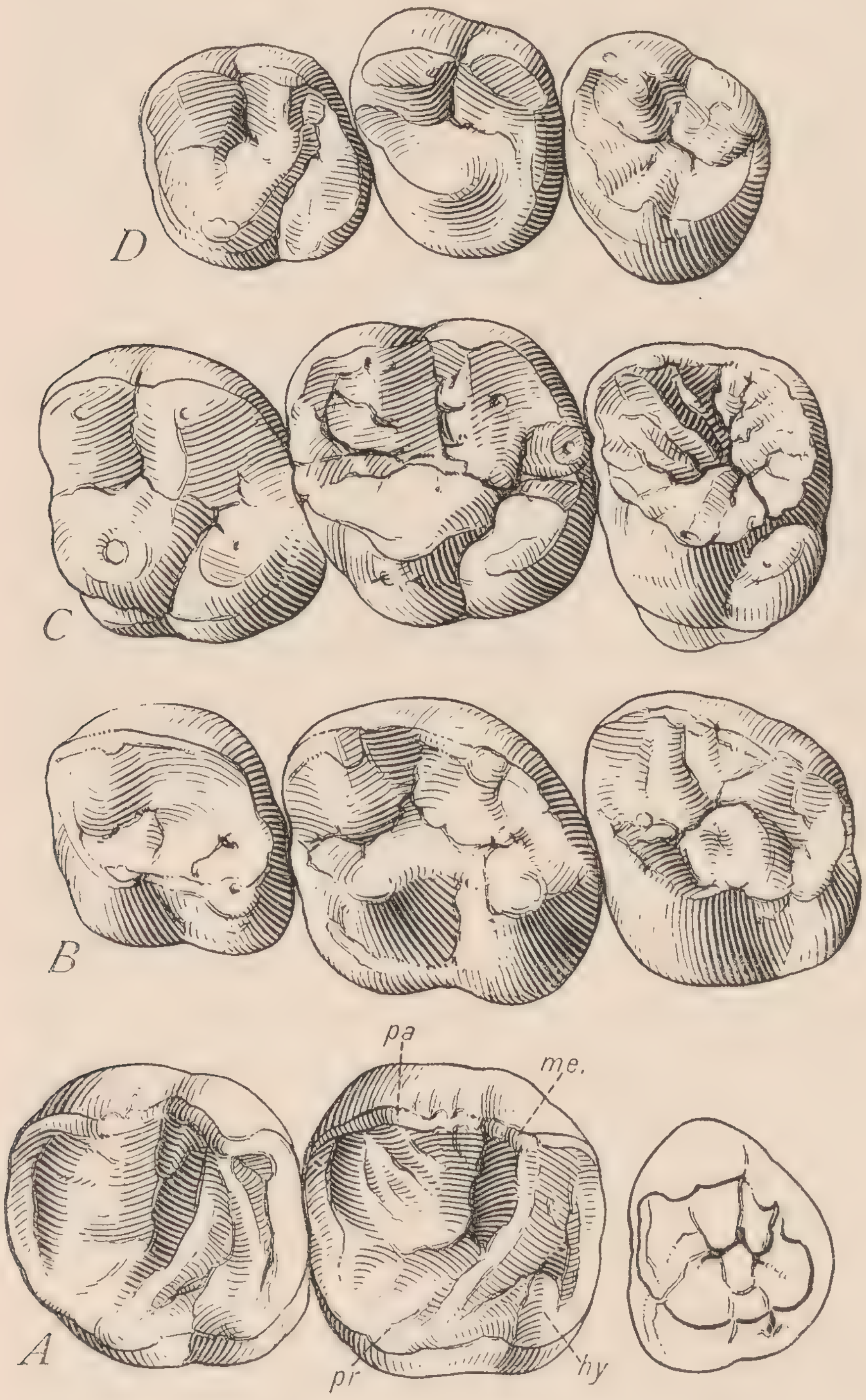

Fig. 35. Comparison of upper molars of men and anthropoids. × $\frac{3}{2}$.

A. *Dryopithecus punjabicus.* After Pilgrim.
B. *Homo neanderthalensis* (Krapina). After Gorganovic-Kramberger.
C. *Homo sapiens.* Kaffir.
D. *Homo sapiens.* Brachycephalic Caucasian.

This shows the wide variation in form of the upper molars of *Homo sapiens*, some specimens approaching *H. neanderthalensis*, with very large quadritubercular crowns, others of retrogressive type, with small tritubercular crowns. The first molar, as usual in anthropoids, is more conservative in pattern, the third molar more irregular and retrogressive.

"The wide palate [known from the Gibraltar skull], the wide dental crowns and big bodies of the teeth seem to indicate powerful side-to-side grinding movements of the mandible during mastication. On the evidence of the teeth and palate one is inclined to regard Neanderthal man as specially adapted to live on a rough vegetable diet." But, in speaking of the Krapina remains, Professor Keith says (op. cit., p. 133): "The superimposed strata [of the cave in which the Krapina Neanderthaloids were found] showing nine different horizons marked by human occupation — hearths, tools, and debris of meals — proved to be the richest treasury of the Neanderthal race ever opened by the explorer's spade. Over two hundred fragments of human skeletons were found, representing at least ten individuals of all ages and both sexes. One hundred upper and one hundred and twenty lower human teeth were collected, all of them showing, in a varying degree, the characteristic form we now associate with the Neanderthal race. Over two thousand fragments of bones of the animals of the period were found, including those of the same ancient form of rhinoceros as occurred at Taubach (*R. Mercki*). The cave-bear occurred abundantly; it was evidently a favorite article of diet. The rhinoceros bones had been broken open to extract the marrow. The mammoth and many other ancient and modern animals were also represented. Some of the human bones were charred, and some had been apparently split open: on that slender basis the Krapina men have been suspected of cannibalism. The implements, like those at Taubach, are not of the typical Mousterian forms, but experts ascribe them to the culture of that period. Some evidence, as at La Quina, was noted of bone having been shaped for use as a tool; perhaps wood was also worked."

Hence in view of this archæological evidence I think it is more than doubtful whether Neanderthal man was "specially adapted to live on a rough vegetable diet." Possibly he was at times a vegetarian by necessity, but in the face of this evidence of his prowess as a hunter one can hardly deny that animal food formed a large part of his diet. Many or perhaps all the early Palæolithic implements with sharp points or with serrate edges would be adapted for piercing the bones, for cutting the tendons, and for stripping off the hide. These implements would materially assist the teeth in the work of getting the food into the mouth; but the very stout deeply implanted molars, with their rough surfaces, would be well adapted for chewing the meat and crushing small bones.

Professors Adloff and Keith both think that the taurodont character of the molars is sufficient to exclude the Neanderthal race from ancestry to *H. sapiens* and hence with other authorities they regard the Neanderthal race as wholly extinct. Now, there are, indeed, many cases in which known Pleistocene genera have some specialized character that appears to exclude them from direct ancestry to the existing types, and it may well be that the same is true in this instance. But it should by no means be regarded as an established fact. Among the Neanderthals themselves there is considerable variation in the degree of "taurodontism" and the same is true of *Homo sapiens*. As regards the form of the upper molars it seems likely that the tritubercular pattern of the second and third upper molars in many skulls of *H. sapiens* is a retrogressive pattern, derived by degeneration from the more vigorously developed, more quadritubercular molars of lower races. At any rate there is a very wide range of form in the molar patterns of *H. sapiens*, so that the Kaffir molars shown in Fig. 35C are actually more like those of the Krapina men than they are like those of typical white men. Hence it seems possible that there may also have been a loss of "taurodontism" in *H. sapiens* correlated with the reduction in size of the jaws and with the use of cooked food.

Consequently I incline to Professor Keith's earlier view (1911, p. 87) which he expressed as follows: "So peculiar are the roots, [of the Neanderthal and in less degree of the Heidelberg molars] so unlike the same structures in the modern type of man and in anthropoids, that Dr. Adloff thinks the Heidelberg man, and the Neanderthal type to which he belongs, cannot be regarded as a stage in the evolution of modern man. In the writer's opinion the form of root just described is a specialization which appeared and subsequently disappeared when the special adaptation was no longer required. The case is similar to the biceps of the blacksmith; the hypertrophy disappears when vigorous demands cease to be made on it. When knowledge ameliorated the quality of the human diet, the overgrown condition in the roots of the teeth disappeared."

There is a tendency among both anthropologists and palæontologists to assume that a marked difference in a given adaptive character between an earlier and a later type excludes the former from ancestry to the latter; because, it seems to be further assumed, evolution is orthogenetic and does not reverse itself! The Neanderthals, say Professors Adloff and Keith in effect, have more specialized molars than modern races have, therefore they cannot be ancestral to them. But what disproves the opposing view that in these characters, modern races (including even the Crô-Magnons) are retrogressive?

M. Boule's extremely careful studies of the postcranial skeleton of the Chapelle-aux-Saints man led him (1912) to the following views: (a) that many of the resemblances between the Hominidæ and the anthropoids are largely homoplastic, or convergent, (b) that the limb structure of man shows in certain features more fundamental resemblances with that of the cynomorph monkeys than with that of the anthropoids, (c) that the Hominidæ have been derived neither from the anthropoid stem nor from any other known group but from a very ancient primate stock that separated from the main line even before the giving off of the lemuroids. Other anthropologists also emphasize the wide genetic separation of the Hominidæ from the anthropoids. "We must vigorously oppose the view often met with in lay circles," says Dr. Bruno Oetteking (1915), "that man developed directly from the anthropoids.... Granting variability, we must assume that from a highly developed vertebrate — a hypothetical paleoprimate — there developed both the anthropoid apes and a being representing man's ancestor."

Now it is of course not the intention of the present writer to urge that the Hominidæ were derived from any still existing genus of anthropoids. But I believe that a concrete and approximately accurate notion of the facts would be given if one were to affirm that the Upper Miocene ancestors of the Hominidæ were at least very closely akin to the Upper Miocene common ancestors of the chimpanzee and gorilla, that they were in fact heavy-jawed, stout limbed, tailless and semi-erect anthropoid Catarrhinæ, with quadritubercular second and third upper molars and *Sivapithecus*-like lower molars.

It was suggested above (p. 321) that the entirely human character of the dentition in the Mid-Pleistocene *Homo heidelbergensis* indicates that the real transitional stages between the anthropoids and the Hominidæ are to be sought in a far earlier epoch, perhaps the Upper Miocene. Hence it is not surprising to find that the Upper Pleistocene *Homo neanderthalensis* differs in many important characters from the recent anthropoids, although retaining quite a few other important anthropoid characters that have been lost in later Hominidæ.

All M. Boule's elaborate discussion of limb ratios and of indices rests upon a comparison of *recent* anthropoids with recent and Pleistocene Hominidæ. But until it is possible to compare the skeletons of Upper Miocene anthropoids with those of their diversified descendants M. Boule's ratios and indices merely record the facts of present divergence and are of ambiguous phyletic significance. We do not know precisely how far the chimpanzee and gorilla have diverged in the characters of the limbs from each other and from the common man-anthropoid stock of the Upper Miocene. But, from the anatomy of the brain, genito-urinary organs and countless other structural and physiological resemblances, we infer with practical certainty that the Hominidæ and the existing anthropoids are the divergent derivatives of a common ancestral stock. And nearly all authorities have recognized that even the existing anthropoids, especially the gorilla and chimpanzee, have on the whole retained the ancestral habitus, with minor changes, while the Hominidæ represent an aberrant terrestrial, bipedal offshoot, primarily of predatory and omnivorous habits.

The whole skeleton of *Homo neanderthalensis* abounds in low characters not found in such an assemblage in any existing specimens of man. But in spite of the opinion of very eminent authorities, no one and no group of these characters, appear to the present writer to exclude this species either from derivation from Upper Miocene anthropoids or from ancestry to *H. sapiens*.

The huge size and strength of the skull, jaws, and dentition are in harmony with the view that the ancestral Hominidæ were ferocious and predatory terrestrial anthropoids. In the great size and depth of the face *H. neanderthalensis* surpasses any recent Hominidæ, which are all more or less retrogressive in the face, dentition and jaws and highly progressive in the brain-case. Consequently all the wide differences in cranial indices ("Kalottenhöhe" etc.) between the Neanderthals and *H. sapiens* do not in themselves exclude the older species from ancestry to the later. Of course the Crô-Magnons and other high types may very well have come into Europe from Asia and the European Neanderthals may simply have crossed with the invading race; but the ancestors of the Crô-Magnons in Asia must have at some earlier time have passed through a Neanderthaloid stage of evolution and perhaps it was some of the older strains of these Pro-Neanderthaloids and not the Mousterian population, which may have given rise at different times and in widely separated regions to the composite group called *H. sapiens.*

It is hardly necessary to believe with Dr. Smith Woodward (1915) that the projecting brow-ridges of male Neanderthals, chimpanzees, and gorillas are quite independently derived characters and that the smooth round brain-case of the young chimpanzee gives the type immediately ancestral both to apes and man. Young mammals usually have relatively larger and more swollen heads than their parents and the heavy crests are not completed until the jaw muscles attain their full size. Through neglect of the phenomenon of cænogenesis certain authors have been led to the absurd conclusion that the swollen brain-case of man and of the smaller Cebidæ is more primitive in form than that of other mammals, a conclusion implying a complete inversion of the palæontological and neontological record. Such a conclusion must have rested upon a complete ignorance of the small brain-case of Eocene mammals of many families and orders. Very likely all the known Miocene genera of anthropoids had brow-ridges, at least in the males, as may be inferred from the massive character of their lower jaws, and the same was probably true of *H. heidelbergensis,* as it was also of *Pithecanthropus* and is of many low specimens of existing Hominidæ. The projecting brow-ridges are associated with stout temporal and masseter muscles and large canines and if the Hominidæ are derived from Upper Miocene anthrpoids they probably had brow-ridges.

The backbone of the Chapelle-aux-Saints man, as admirably described by Boule, resembled that of a chimpanzee and differed from that of recent Hominidæ especially in the form of the cervical vertebræ and in the forward curvature of the neck, characters associated with many ape-like peculiarities of the skull. The forward curve of the lumbar region was also less pronounced than in existing Hominidæ and the whole conformation of the skull and backbone shows that the upright posture and the balancing of the skull upon the column were very imperfectly developed in this upper Pleistocene species. The extremely robust ribs, which in volume greatly surpass that of any modern races, testify to the massive musculature of the thorax, which is in harmony with the gigantic and very powerful head and neck.

The pelvis is prevailingly human in character, having the widely expanded ilia of man rather than the long narrow ilia of the chimpanzee. This human character of the pelvis suggests an equally human development of the enclosed viscera. It also implies essentially human conformation of the glutæi, psoas, iliacus and many other locomotive muscles. Although the difference between the human pelvis and the anthropoid types of pelvis is very marked the former is clearly a structural derivative of the latter. A spreading, basin-like ilium has in other phyla of mammals very frequently been evolved out of a narrow blade-like ilium, as in many groups of ungulates. Moreover there is a steady rise in the pelvic index, *i. e.*, in the breadth of the ilium, as we pass from the Eocene lemuroids, through the South American and cynomorph monkeys to the gibbon, orang, chimpanzee, gorilla, and man.

The legs of the Neanderthal race were of human type, distinguished by the relatively short tibia, the partial retroversion of the head of the tibia, showing that the knee was slightly bent even in the erect pose, and the presence of accessory facets for the tibia on the astragalus, similar to those observed in cynomorph monkeys and in modern human races that squat instead of sitting. "There are other features," observes Professor Osborn (1915, p. 238), "which would tend to show that the ancestors of the Neanderthaloids had been ground dwellers rather than tree dwellers back into a very remote period of geologic time; the arms are much shorter than the legs, whereas in tree dwellers they are much longer. . . . Thus, to sum up the bodily proportions of the Neanderthals:

Arm short in proportion to leg, average index 68 percent.

Forearm short in proportion to upper arm, average index 73.8 per cent.

Shin bone short in proportion to thigh bone, average index 76.6 per cent.

Stature extremely short in proportion to size of head."

The foot of the Neanderthals is essentially human with a few primitive features of the astragalus. The lack of truly intermediate stages between the human and the anthropoid types of foot may well be cited by those who regard the Hominidæ as a family of mysterious, unknown affinities which branched off in the Eocene or even earlier. The human foot is so completely adapted for erect bipedal progression on the ground and it is so markedly different from the anthropoid foot, which is adapted for grasping the limbs of trees, that the opinion has been expressed that the human foot has not been derived at all from the anthropoid type. Briefly the contrast between these two types of foot is as follows:

(1) The hallux in the anthropoids is highly opposable. It is sharply divergent and articulates by a saddle-shaped facet on the obliquely placed entocuneiform and is operated by very powerful flexor and adductor muscles. Its plantar surface faces the other digits and its dorsum is turned sideways. The cleft between the hallux and the other digits extends far toward the proximal end of the foot, and the tip of the hallux does not extend to the end of the other digits. The foot as a whole is broad, spreading and flat and the sole faces inward. The digits are curved inward and, in proportion to digit I, digits II, III, IV are all larger than in man. The phalanges are relatively long and are much flexed. The trochlea of the astragalus is tilted outward, in accordance with the marked supination of the foot. Such a foot is adapted for grasping the branches and practically serves also to some extent as a hand. By means of its strong grasping power of the pes the animal can stand completely erect when in the trees (Keith, 1911), but the anthropoid pes is very ill adapted for walking on smooth ground,

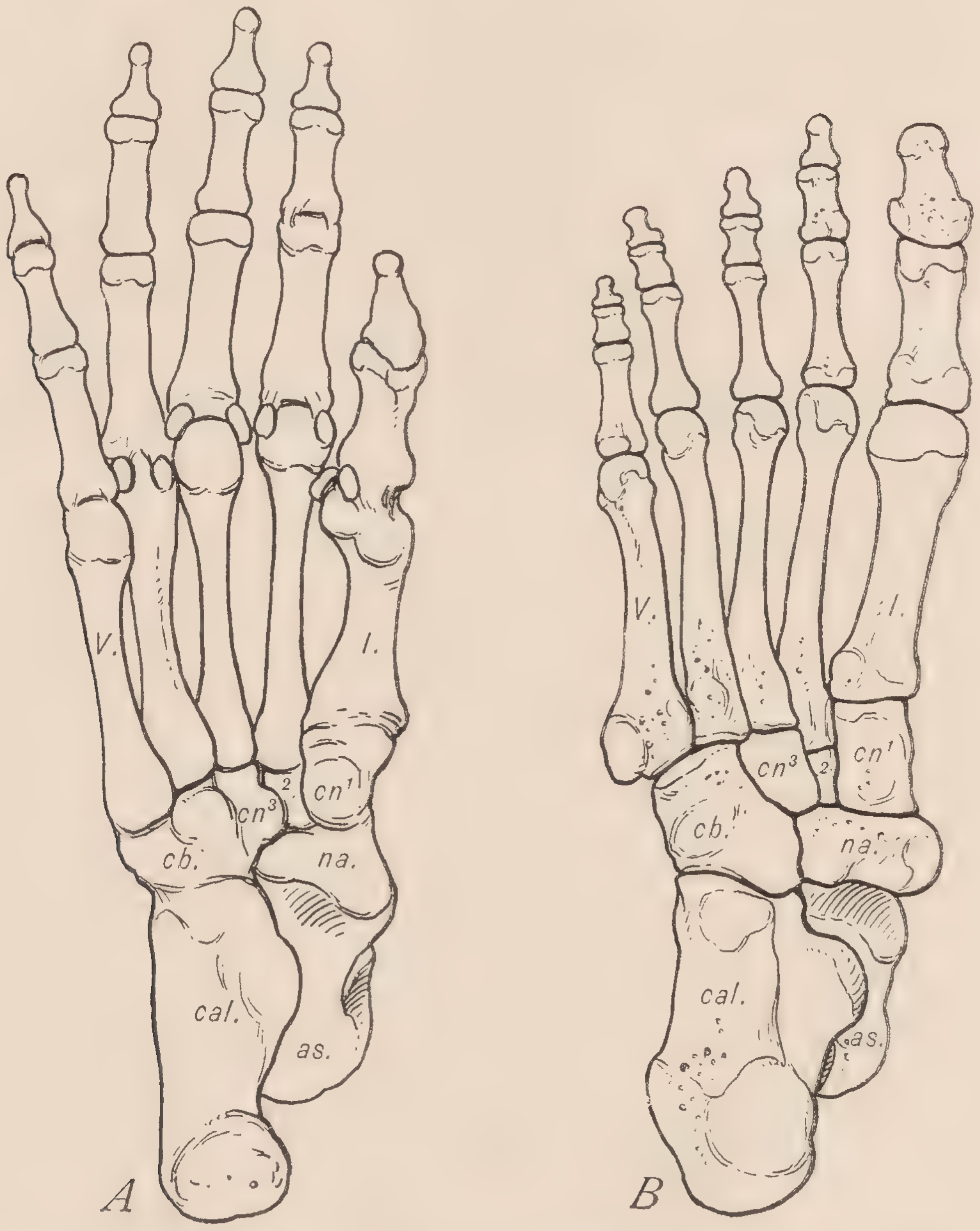

Fig. 36. Plantar aspect of the foot in (A) an infant gorilla and in (B) man (Australian black, ♀), contrasting the semi-arboreal and the cursorial terrestrial types.

In order to show the comparative lengths of the phalanges the distances from the tip of the second metatarsal to the back of the tuber calcis are reduced in both figures to the same absolute length.

where there is nothing to grasp, and causes the animal to be very unsteady and clumsy when it attempts to walk fully upright on the ground.

(2) In the pes of man on the other hand the hallux is not at all opposable. It is not divergent but nearly parallel to the other digits. Its planar surface faces downward. It articulates by a concave or flattened facet with the more rectangular entocuneiform. The great flexors and adductors of the hallux coöperate with other muscles in giving a powerful thrust upon the ground. The cleft between the hallux does not extend much beyond the phalanges, so that the hallux and other digits are encased in a common integument extending to the end of the metatarsals. The tip of the hallux often extends beyond the other digits. The foot as a whole is narrow, compressed, and arched, and the sole faces entirely downward. The digits are straight; digit I is much the largest and longest while the other digits are all weak. The phalanges are short and not flexed. The trochlea of the astragalus faces superiorly instead of obliquely, in accordance with the fully pronate position of the foot. Such a foot is adapted solely for erect, bipedal locomotion in walking, running, and jumping. There are of course other differences between the human and anthropoid types of pes but the above mentioned ones are sufficiently distinctive.

Now it is an incontestable fact that a steady general progression toward the human type of foot may be observed if one will arrange a series in the following order: (1) Eocene lemuroid *Notharctus*, (2) Old World monkey, (3) young gorilla, (4) *Homo*. This may not be a true genetic series, but I believe that it reveals the general course of evolution as follows:

The oldest known type of Primate foot, that of the Middle Eocene *Notharctus*,[1] was fully adapted for very firmly grasping the branches and proves that this primary adaptation of the Primate foot was acquired at a very early date, perhaps in the Paleocene. The metatarsals are very short. The hallux is even larger than it is in *Lemur*. It has a large broad process at its proximal end for the attachment of the peroneus longus muscle and this process interlocks with the surrounding elements in such a way that it narrowly limits the opposability of the hallux, which is always sharply divergent from the other digits. The phalanges of the hallux are of large size and the distal phalanx is widely flattened and affords a firm attachment for the powerful flexors. The phalanges of the other digits are long, but much less so than in modern lemurs. The fourth digit was probably the longest. The astragalus of this type has a narrow, asymmetrical flat trochlea without marginal keels, a relatively long oblique deck and a narrow slender head. This type of foot is carried to its extreme development in the modern

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[1] This will be fully described in Part IV of the present series of studies.

Indrisine lemurs. It is primarily adapted for a very firm grasp of the branches and secondarily for leaping. In walking on the ground the hallux serves as a wide strut, that projects inward, as may be observed in modern lemurs.

(2) The foot of an Old World monkey differs from the primitive type chiefly in (a) the reduction of the peroneal process of the hallux, which has therefore more flexibility, more opposability, (b) the lengthening of the metatarsals and (c) the readjustment of the lengths of the digits so that digit IV is slightly shorter than digit III. (d) The astragalus has a wide trochlea with marginal keels. (e) In walking the hallux is not turned inward quite as sharply as it is in the lemurs. Such a type of foot is somewhat better adapted for free and active quadrupedal running along the tops of the branches as well as on the ground; and it also serves for grasping.

(3) The foot of the gorilla shows some approach toward the human type, especially in the following characters: (a) in adaptation to the gigantic size and weight of the animal, the phalanges are notably shorter than in preceding types and the metatarsals are stouter; (b) the digits decrease in massiveness from I to V; (c) the astragalus has lost the trochlear keels and is widened, so that in general form it distinctly approaches the human type; (d) the tuber calcis is expanded and forms a true heel; (e) the foot as a whole shows the beginning of an arch; (f) in walking on the smooth ground the phalanges, being shorter, are not flexed so much as they are in lower Primates, and the sole of the foot is planted more directly upon the ground.

(4) It may well be that the gorilla, as the result of its giantism and of its partial assumption of terrestrial habits, is acquiring at a late date characters which the Hominidæ acquired more perfectly at a far earlier period, perhaps in the Upper Miocene. But in order to transform a gorilla-like foot into a human foot it is chiefly necessary: (a) to increase the length of the hallux, (b) to adduct it, and rotate it on its own axis so that its plantar surface shall be applied to the ground instead of facing toward the other digits. (c) Next it would be necessary to shorten still further the phalanges and (d) to narrow the whole foot, that is to make all the digits parallel instead of divergent. (e) The tuber calcis and cuboid must be enlarged and (f) the whole foot must be "pronated" or made to face downward rather than inward. As a result (g), the trochlea of the astragalus is made more symmetrical, deeper on the tibial malleolar facet, (h) the head of the astragalus is widened.

Those who lose sight of the fundamental principle of the change of function and who expect remote ancestral stages to foreshadow *all* the features of the final stage will hardly realize that by the foregoing relatively slight morphological changes a gorilloid type of foot could be easily made over for service on the ground. And if man has descended from any primitive Primate, whether lemuroid, cynomorph or anthropoid, such are the changes which undoubtedly must have occurred.

But, it may be objected, this is not what actually did happen in other and better established instances, as when the arboreal marsupial foot was made over into the various ground-living types, or when the aboreal primitive placentals were transformed into the swift running carnivores and ungulates of the Eocene. To such an objection I would reply that in these other instances we have to do solely with the transformation of arboreal plantigrade quadrupeds into terrestrial digitigrade quadrupeds. In such cases the hallux, upon the adoption of terrestrial quadrupedal progression, is very often lifted clear of the ground and rapidly dwindles away, as in the Dasyuridæ. And in such cases the hallux in the primitive arboreal forms is by no means as large and powerful as it is in the primitive lemuroids and anthropoids. But in the transformation of a gorilloid form of foot into the human type we have to do with widely different conditions, namely the transformation of erectly sitting, brachiating quadrumana into erectly walking, plantigrade bipeds. When the Miocene ancestors of the Hominidæ began to spend more time on the ground and less time in the trees it was perfectly natural that their powerful hallux should have been utilized as the main axis of the foot, instead of the weaker digits II, III, IV; because on rough forest ground the strongly grasping hallux with its powerful flexors and adductors would be almost as useful in maintaining the balance in the upright pose as it would in the trees.

The assumption of the erect attitude in the Hominidæ has involved many other readjustments and reversals in the proportional lengths of the limb segments — readjustments, of which the true significance has been largely missed by those who put their trust in ratios and indices. It is often held that the relatively long arms and short legs of the chimpanzee and gorilla as compared with those of man are aberrant specializations which remove these apes from the direct ancestry to man. But long arms and short legs are used in brachiating, and short legs are especially advantageous in squatting, the favorite posture of the gorilla. Now both brachiating and squatting form I believe a necessary introduction to the upright posture of man. The habit of brachiating, or swinging from branch to branch with the arms, trained the arms in the all important power of supination and improved the brain, eyes and all the balancing mechanism. The habit of sitting upright conditioned the loss of the tail and the further development of all those characters of the backbone, thorax and pelvis which give to the anthropoid skeleton a distinctly subhuman look. Moreover the habit of sitting upright tended greatly to encourage the use of the hands.

But long arms and short legs are also very useful in progression upon the ground and especially in the forest, as one can readily see from Mr. Raymond L. Ditmar's excellent motion pictures made in the New York Zoölogical Park. This peculiar method of taking great strides with the forearms, in a semi-erect posture, again forms a necessary prelude to fully erect bipedal progression. It must have been abandoned only when the primitive apemen took to carrying weapons or food in their hands, and when through the use of jagged flints the arms became terrible fighting weapons.

With all respect to the contrary views of very eminent authorities, such as M. Boule and Professor Klaatsch it seems perfectly evident that the long legs and short arms of man form a secondary specialization for erect bipedal progression upon the ground and that all resemblances in the proportions of the fore and hind limb between man, the cynomorphous monkeys and certain lemuroids are entirely secondary. Both the long femur and the long tibia of man greatly lengthen the stride and increase the speed, factors of vital importance in a hunting and fighting animal, but of less importance to the clumsy frugivorous anthropoids. The short arms in man are also more powerful and of greater advantage in fighting with weapons. On the other hand the opposite proportions, namely long legs and short arms, in the tree living anthropoids would be inconsistent with the fully upright posture in sitting and with the habit of brachiation, and such arboreal animals as happen to have long legs and shorter arms, as in the *Galago*, although accidentally approaching man in this respect, have these proportions because they are specialized for leaping, in a manner utterly different from the erect bipedal progression of man. Moreover long hind limbs, while permissible in a small arboreal animal like the gibbon, would be quite inconsistent with the upright pose, in the trees, of a heavy animal like a full grown chimpanzee or gorilla, since they would make it more difficult to maintain the balance.

M. Boule is impressed by the fact that in some of the cynomorph monkeys the disproportion in length between arms and legs is less than it is in the anthropoids and he therefore seems to favor the view that man may have been derived from some arboreal form more or less resembling the cynomorphs in the humero-femoral ratio. But the cynomorphs have relatively short arms and long legs precisely because they are quadrupeds, and they walk upright only with the greatest difficulty. It is true that they can sit partly upright, but in the whole skull, backbone, and pelvis they are far less man-like than the anthropoids.

In brief I can discover no valid objection to the view that the Upper Miocene forerunners of the Hominidæ had short stout femora and long arms much like those of baby gorillas. As terrestrial bipedal progression was adopted the femora and tibiæ lengthened out while the forearm was reduced in length but gained in thickness.

Those who admit that the trend of evolution sometimes changes, following a change of habits, can find plenty of precedence for the reduction in size of one part and the increase of another: the reduction of the face and jaws and the great increase in the brain-case in man being a case in point. Among the Lemuroidea many analogous cases of reversal in evolutionary trend occur. *Megaladapis* is undoubtedly an aberrant derivative of some normal primitive lemur like *Lepilemur*, but *Megaladapis* has the hind limb bones secondarily shortened and widened, while all the primitive lemurs have them long and slender.

An admirable example of a profound readjustment of proportions, following upon a change in habits, is furnished by the limbs of Pinnipedia, of all families. The pinniped foot resembles broadly a much enlarged human foot which has been flattened out and spread apart. The hallux is much enlarged and exceeds the other digits in size and length. Now although the direct ancestors of the Pinnipedia are not known it is practically certain that they have been derived from primitive terrestrial carnivores of some sort, as shown especially by the morphology of the skull. But no primitive terrestrial carnivore or even terrestrial Eutherians of any known family had hands and feet like those of pinnipeds. Primitive carnivores and primitive placentals were on the contrary digitigrade animals with short metapodials and a normal hallux, which is never as large as it is in the pinnipeds. The change of habits from terrestrial to aquatic life has conditioned a profound readjustment in the proportions of all parts of the limbs: not only has the hallux become very large and long and the other digits variously readjusted in length and proportions, but the femur has become extremely short and broad and the whole pelvis has been remodeled on lines quite foreign to the pelvis of terrestrial mammals.

A change from normal terrestrial to fossorial habits has in the Talpidæ produced a profound readjustment of limb proportions. The primitive terrestrial type is still extant in the Thibetan *Uropsilus soricipes,* which is a true talpid in skull and dentition but retains very primitive shrew-like limbs. At the other extreme the specialized fossorial habits of *Talpa* have conditioned an excessive widening of the hands and shortening of the metatarsals, an excessive widening and shortening of the clavicle which has lost all resemblance to a normal clavicle, a great widening and remodeling of the humerus, and a great lengthening and narrowing of the scapula. But if one were to compile an imposing series of comparative limb ratios and indices of *Talpa* and *Uropsilus* the contrasts would be so enormous that no conservative statistician would dare to suggest that there is a close relationship between these two genera.

A constant and long continued study of the evolution of very many orders and families of fishes, amphibians, reptiles and mammals has brought to my notice so many striking examples of profound readjustments in proportions and indices following upon marked changes in function that it seems amazing to me that the relatively small morphological differences between the limbs of *Gorilla* and those of *Homo* should frighten some authors into constructing purely hypothetical phylogenies in which these two related genera are placed far apart.

In short I hold that as the ancestral Hominidæ gave up arboreal frugivorous and semiquadrupedal habits and assumed the life of hunters upon the ground, the hind limb, especially the femur became longer, the hallux was lengthened, rotated about its own axis and brought into alignment with the other digits, the forearm shortened and the pollex became larger.

VI. Phylogenetic Summary and Conclusions.

1. *Phyletic Relations of the Tertiary and Quaternary Anthropoids.*[1]

(Fig. 37.)

Parapithecus and *Propliopithecus.*— The earliest known member of the anthropoid series, the genus *Parapithecus* of the Lower Oligocene of Europe, foreshadows the true anthropoids in the fundamental pattern of its premolars and molars and appears to be structurally intermediate between an Eocene partly insectivorous anaptomorphoid stage with pointed jaws and small canines and a true anthropoid stage.

Parapithecus must be regarded as a persistent primitive type, for its contemporary *Propliopithecus* is already a true and very primitive anthropoid ape, with a deep jaw and with the highly characteristic dentition, although much smaller and more primitive even than the modern gibbon, as rightly maintained by Dr. Schlosser.

Pliopithecus.— This genus of the Upper Miocene and Lower Pliocene of Europe appears to be intermediate between *Propliopithecus* and the modern gibbon. Its jaw is more primitive than that of the latter in its divergent rami, smaller canines, wider premolars and unreduced third lower molar.

Palæosimia.— This genus, from the Upper Miocene of India, so far as known, appears to be ancestral to the orang-utan.

Sivapithecus.— This Upper Miocene Indian genus appears to the present writer to be closely related to *Dryopithecus,* as a descendant of a common stem resembling *Propliopithecus.* In another direction it appears to be related to *Palæosimia* and the orang. It approaches man not only in the greater breadth index of the premolars and molars, but also in their fundamental pattern. It retains the high conic canines, which were probably reduced in the Hominidæ. According to the writer's interpretation *Sivapithecus* also exhibited an ape-like arrangement of the cheek teeth, in parallel rather than convergent rows. It should therefore be referred, by definition, to the Simiidæ rather than to the Hominidæ.

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[1] Until all or nearly all these genera and species are known from both the upper and the lower molars the exact relationships and status of some of them must remain indefinite.

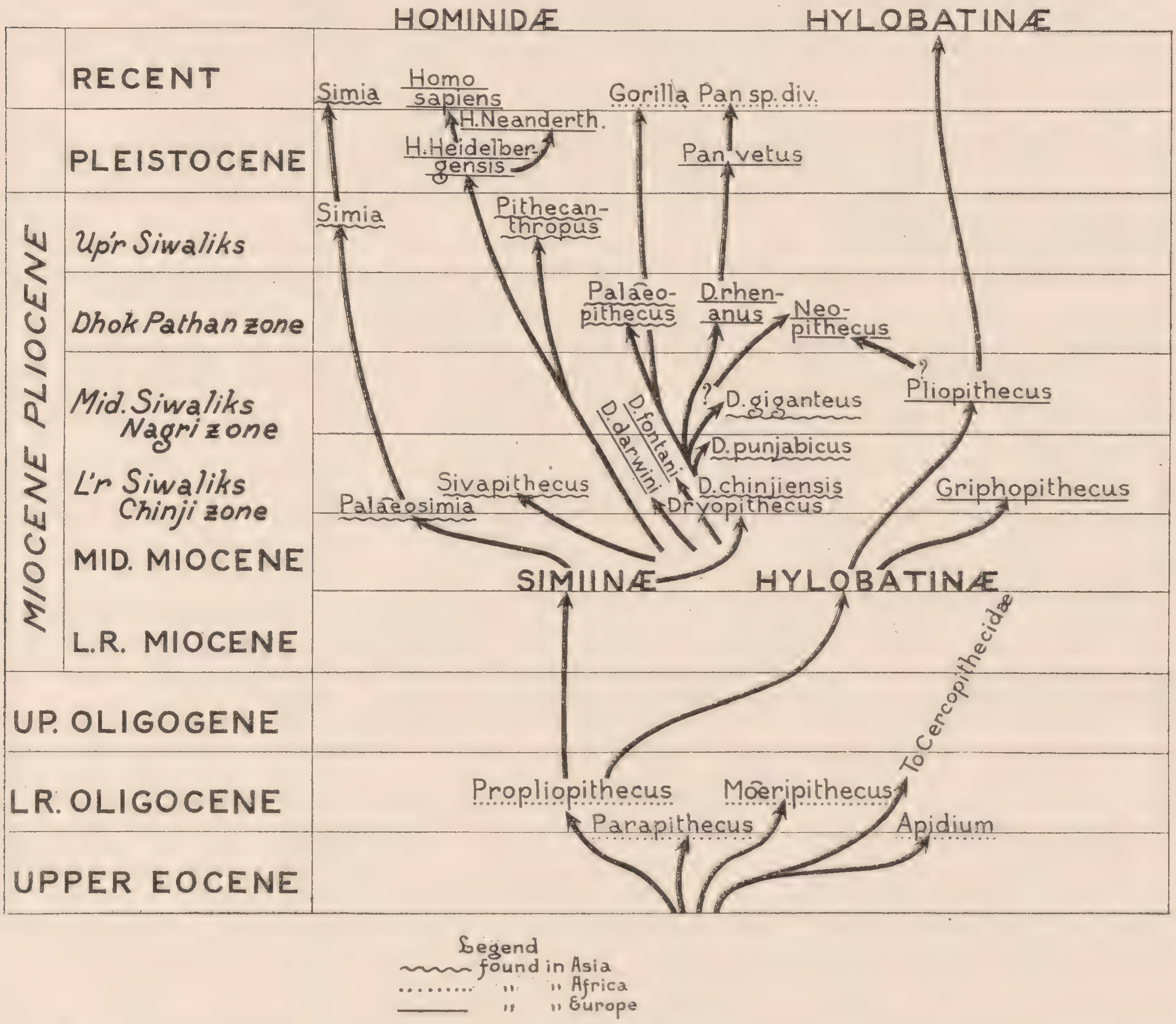

Fig. 37. Geological succession and provisional phylogeny of the Hominidæ and Simiidæ, as interpreted from available evidence by the author.

Dryopithecus.— This Upper Miocene and Lower Pliocene genus, which is known from three species in India and three in Europe, retains strong evidence of derivation from a form like *Propliopithecus*, but is much larger and more progressive. Its molars and premolars are ancestral in pattern not only to those of the chimpanzee and gorilla, but also to those of man.

Dryopithecus chinjiensis (of India) may be the remote ancestor of the gorilla line.

Dryopithecus punjabicus (of India) seems to be closely allied or ancentral both to the gorilla and the chimpanzee.

Dryopithecus giganteus (of India) is very much larger than the other species and appears to be closely related to the chimpanzee.

Dryopithecus darwini (of Europe) is known from a third lower molar, which is unusually short and wide and has deep furrows and wrinkles. Its exact relationships are uncertain; perhaps it is related to *Pithecanthropus.*

Dryopithecus fontani (of Europe) is known from lower jaws and teeth, which appear to be allied in many characters to *D. chinjiensis* and to the modern gorilla.

Dryopithecus rhenanus (of Europe) is in some ways more specialized than *D. fontani* and may be intermediate between *D. punjabicus* and the chimpanzee.

Palæopithecus.— This genus is known from a palate and upper teeth from the Lower Pliocene of India. It appears to the present writer to be related to the gorilla.

Neopithecus ("*Anthropodus*").— A third lower molar of doubtful relationships, perhaps related to *Dryopithecus rhenanus,* but with a narrow m_3.

Anthropopithecus (*Pan*) *vetus*).— An extinct Pleistocene species represented by a lower jaw found near the Piltdown skull. The last survivor of the *Dryopithecus* group in Europe. Teeth and jaw differ greatly from those of the oldest known man, *H. heidelbergensis,* and are not generically separable from the modern *Anthropopithecus* (Pan), as held by Miller.

Pithecanthropus.— The two upper molars referred to this genus are of very large size; in pattern and contour they suggest relationships with the *Dryopithecus*-group as well as with *Sivapithecus* and *Homo.*

2. *Origin of the Recent Anthropoids.*

The Gibbons.— In a recent phylogenetic diagram Dr. Pilgrim (1915) unites the gibbon stem with the human stem in the Upper Oligocene and places a very deep cleft between this gibbon-man trunk and the *Pliopithecus-Dryopithecus* group and its derivatives the modern great apes. This view of the nearer relationship of man to the gibbons rather than to the "giant apes" may be said to be flatly opposed by the anatomical results of many investigators. "The brain of the gibbon," says Keith (1896) p. 372), "is comparatively small and simple, resembling in its form and topography much more the brains of cynomorphous monkeys than those of the three great anthropoids." The brain of the Giant Apes on the other hand in the words of M. Weber (1904, p. 809) . . . . "ist ein vereinfachtes Menschengehirn, dem aber nichts Wesentliches fehlt."

Again, in summarizing the results of his complete dissection of eighty specimens of the higher Primates, Professor Keith gives a tabular analysis (1911, p. 509) of over a thousand characters observed in the gibbon, from which the following comparison is taken:

Total number of characters examined over 1000	Common to gibbon and cynomorphs 323	Common to gibbon and to all other anthropoids and man 133	Common to gibbon and man alone 84
980	Common to chimpanzee and cynomorphs 172	Common to chimpanzee and to all other anthropoids and man 133	Common to chimpanzee and man alone 98

But these figures hardly convey a correct impression of the relative degrees of affinity of the gibbon to man and to the great apes, since the characters are recorded numerically and are not evaluated according to their phylogenetic importance.

"As to the position of the gibbons in the series of primates," remarks Keith (1896, p. 376), "there is a tendency at present, with which the writer is in sympathy, to remove the gibbons altogether from the company of the anthropoids and place them in a position intermediate between the great apes and the cynomorphous monkeys.... They are really cynomorphous monkeys adapted to locomotion in an upright posture" (1896, p. 376). The present writer, however, regards the Hylobatidæ rather as aberrant Simiidæ, widely removed from the Cercopithecidæ.

In short the dental, osteological and anatomical characters of the gibbons appear to indicate that these apes represent an earlier offshoot of the anthropoid stem, as held by most authorities, and that the giant apes and man represent a later radiation. Comparative anatomical evidence sufficiently establishes the fact that the gibbons have been derived from the same brachiating and frugivorous catarrhine apes that gave rise to the whole man-anthropoid series. The derivation of the Gibbons from *Pliopithecus* of the Upper Tertiary of Europe is defended above (p. 301).

Apart from their primitive anthropoid characters the gibbons resemble man chiefly in the features wherein they have avoided the specializations of the giant apes. The rounding and reduction of the third lower molars are probably secondary characters analogous with similar retrogressive characters in the orang, chimpanzee and man.

The Orang-utan.— Professor Keith's vast labors on the anatomy of the anthropoids show: first that from the viewpoint of comparative anatomy the orang stands on a much higher plane than the gibbon, that is it has advanced further on the road toward extreme arboreal, frugivorous adaptation, toward a higher brain and mentality and toward gigantic size; secondly, that it stands well apart from the chimpanzee-gorilla group; and thirdly, that in the majority of its characters the orang is less man-like than the gorilla and chimpanzee.

The possible derivation of the Orang from the Miocene Asiatic genus *Palæosimia* is discussed above (p. 286).

The Chimpanzee.— Many features of the skull and skeleton of the chimpanzee are prophetic of the more specialized conditions in the gorilla. These two apes are indeed so closely allied that until recently both were referred to a single genus *Anthropopithecus.* Certain chimpanzees have exhibited strong resemblances to the gorilla, so that their status as chimpanzees was only determined by careful investigation (Keith, 1899), while on the other hand immature and female gorilla skulls to some extent suggest those of the chimpanzee.

The anatomist Tyson in 1699 published an excellent account of the anatomy of the chimpanzee, which he regarded as a distinct type of man (*Homo sylvestris*), and since then all observers have noted the close relationships of this ape to man in its anatomy, physiology and mental activities.

The derivation of the chimpanzee-gorilla group from one of the Miocene species of *Dryopithecus* is discussed above (p. 296–298, 337).

The Gorilla.— Morphologists who have had the opportunity of studying the young female gorilla, as well as the gibbons and other anthropoids now or lately living in the New York Zoölogical Park, can hardly fail to be impressed with the superiority of the gorilla's claim to human kinship as compared with that of the other anthropoids, especially the gibbon. This is shown not only in the face, hands and feet and other parts of the body, but in the deep-seated functions of the digestive and reproductive systems. The gorilla, is in fact extremely manlike in many organs of high morphological significance, such as the brain, the sternum, the region of the auditory bulla, the external ear, the genital organs, the mammæ, the heart, and the eye. The musculature of the gorilla also presents many human characteristics. (*Cf.* Duckworth, 1915.)

In adopting a partly terrestrial habit the gorilla has entered upon a line of adaptation which in the forerunners of man resulted in a fully bipedal, cursorial type, capable of invading the plains. But as the gorilla is largely frugivorous and limited to the forests and their neighborhood the only course left for it (apart from its inevitable extinction by man) would have been to go on increasing still further in size until it might have surpassed even the Kadiak bear in bulk. Such a beast might have ambled along on all fours, partly supporting itself upon its knuckles as the gorilla now does.

The probable derivation of the gorilla from one of the Miocene Asiatic species of *Dryopithecus* is discussed on pages 297, 337.

3. *The Origin of Man.*

Most anthropologists have specialized almost exclusively in their own field and have not acquired a practical knowledge of the evolution of the mammals, so far as it is known in many orders and families of mammals throughout the Tertiary and Quaternary Periods. Such specialists are impressed by the great and obvious differences between mankind and the existing anthropoids. They often magnify the phylogenetic importance of these differences, sometimes to the extent of supposing that the derivation of man is still veiled in complete mystery, or that the separation of the Hominidæ from the ancestral primate stock took place even before the differentiation of the Lemuroidea and Anthropoidea.

Many palæontologists, impressed with the vast antiquity of *Homo sapiens* as estimated in years, and with the fact that even the older Pleistocene species of Hominidæ were already widely separated from the anthropoids in tooth and limb structure, are inclined to push back the point of separation of the Hominidæ and the anthropoids into the early Tertiary.

In the present work the chief conclusions, which appear to be of a conservative character, are as follows:

1) Comparative anatomical (including embryological) evidence alone has shown that man and the anthropoids have been derived from a primitive anthropoid stock and that man's nearest existing relatives are the chimpanzee and gorilla.

2) The chimpanzee and gorilla have retained, with only minor changes, the ancestral habits and habitus in brain, dentition, skull and limbs, while the forerunners of the Hominidæ, through a profound change in function, lost the primitive anthropoid habitus, gave up arboreal frugivorous adaptations and early became terrestrial, bipedal and predatory, using crude flints to cut up and smash the varied food.

3) The ancestral chimpanzee-gorilla-man stock appears to be represented by the Upper Miocene genera *Sivapithecus* and *Dryopithecus* the former more closely allied to, or directly ancestral to, the Hominidæ, the latter to the chimpanzee and gorilla.

4) Many of the differences that separate man from anthropoids of the *Sivapithecus* type are retrogressive changes, following the profound change in food habits above noted. Here belong the retraction of the face and dental arch, the reduction in size of the canines, the reduction of the jaw muscles, the loss of the prehensile character of the hallux. Many other differences are secondary adjustments in relative proportions, connected with the change from semi-arboreal semi-erect and semi-quadrupedal pro-

gression to fully terrestrial bipedal progression. The earliest anthropoids being of small size doubtless had slender limbs; later semi-terrestrial semi-erect forms were probably not unlike a very young gorilla, with fairly short legs and not excessively elongate arms. The long legs and short arms of man are due, I believe, to a secondary readjustment of proportions. The very short legs and very long arms of old male gorillas may well be a specialization.

5) At present I know no good evidence for believing that the separation of the Hominidæ from the Simiidæ took place any earlier than the Miocene, and probably the Upper Miocene. The change in structure during this vast interval (two or more million years) is much greater in the Hominidæ than in the conservative anthropoids, but it is not unlikely that during a profound change of life habits evolution sometimes proceeds more rapidly than in the more familiar cases where uninterrupted progressive adaptations proceed in a single direction.

6) *Homo heidelbergensis* appears to be directly ancestral to all the later Hominidæ.

4. *On the evolution of human food habits.*

While all the great apes are prevailingly frugivorous, and even their forerunners in the Lower Oligocene have the teeth well adapted for piercing the tough rinds of fruits and for chewing vegetable food, yet they also appear to have at least a latent capacity for a mixed diet. The digestive tract, especially of the chimpanzee and gorilla, is essentially similar to that of man and at least some captive chimpanzees thrive upon a mixed diet including large quantities of fruits, vegetables and bread and small quantities of meat (Keith 1899). Mr. R. L. Garner who has spent many years in studying the African anthropoids in their wild state, states[1] that "their foods are mainly vegetable, but that flesh is an essential part of their diet." Other observers state[2] that the gorilla and chimpanzee greedily devour young birds, as well as eggs, vermin and small rodents.

Even the existing anthropoids, although highly conservative both in brain development and general habits, show the beginning of the use of the hands, and trained anthropoids can perform quite elaborate acts. At a time when tough-rined tubers and fruits were still the main element of the diet the nascent Hominidæ may have sought out the lairs and nesting places of many animals for the purpose of stealing the young and thus they may have learned to fight with and kill the enraged parents. They had also learned to fight in protecting their own nesting places and young. And possibly they killed both by biting, as in carnivores, and by strangling, or, in the case of a small animal, by dashing it violently down.

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[1] Science, vol. XLII, Dec. 10, 1915, p. 843.

[2] Keane, Ethnology, Cambridge 1901, p. 111.

We may conceive that the Upper Tertiary ape-men in the course of their dispersal from a south central Asiatic centre (Matthew, 1915, pp. 210, 214) entered regions where flint-bearing formations were abundant. In some way they learned perhaps that these "Eolith" flints could be used to smash open the head of a small strangled animal, to crack open tough vegetables, or to mash substances into an edible condition. Much later, after the mental association of hand and flint had been well established, they may have struck at intruders with the flints with which they were preparing their food and in this way they may have learned to use the heavier flints as hand axes and daggers. At a very early date they learned to throw down heavy stones upon an object to smash it, and this led finally to the hurling of flints at men and small game. Very early also they had learned to swing a heavy piece of wood or a heavy bone as a weapon. For all such purposes shorter and stockier arms are more advantageous than the long and slender arms of a semi-quadrupedal ancestral stage and I have argued above (p. 333) that a secondary shortening and thickening of the arms ensued.

One of the first medium-sized animals that the nascent Hominidæ would be successful in killing was the wild boar, which in the Pleistocene had a wide Palæarctic distribution.

From the very first the ape-men were more or less social in habits and learned to hunt in packs. Whether the art of hunting began in south central Asia or in Europe, perhaps one of the first large animals that men learned to kill after they invaded the open country was the horse, because, when a pack of men had surrounded a horse, a single good stroke with a coup-de-poing upon the brain-case might be sufficient to kill it.

I have argued above (p. 321) that the retraction of the dental arch and the reduction of the canines is not inconsistent with the use of meat as food, because men learned to use rough flints, in place of their teeth, to tear the flesh and to puncture the bones, and because the erect incisors, short canines and bicuspids were highly effective in securing a powerful hold upon the tough hide and connective tissue. It must be remembered that with a given muscular power small teeth are more easily forced into meat than large teeth.

After every feast there would be a residuum of hide and bones which would gradually assume economic value. The hides of animals were at first rudely stripped off simply to get at the meat. Small sharp-edged natural flints could be used for this purpose as well as to cut the sinews and flesh. After a time it was found that the furry sides of these hides were useful to cover the body at night or during a storm. Thus the initial stage in the making of clothes may have been a biproduct of the hunting habit.

Dr. Matthew (1915, pp. 211, 212) has well suggested that men may have learned to cover the body with the skins of animals in a cool temperate climate (such as that on the northern slopes of the Himalayas) and that afterward they were able to invade colder regions. The use of rough skins to cover the body must have caused exposure to new sources of annoyance and infection, but we cannot affirm that natural selection was the cause of the reduction of hair on the body and of the many correlated modifications of glandular activity. We can only affirm that a naked race of mammals must surely have had hairy ancestors and that the loss of hair on the body was probably subsequent to the adoption of predatory habits.

The food habits of the early Hominidæ, and thus indirectly the jaws and teeth, were later modified through the use of fire for softening the food. Men had early learned to huddle around the dying embers of forest fires that had been started by lightning, to feed the fire-monster with branches, and to carry about firebrands. They learned eventually that frozen meat could be softened by exposing it to the fire. Thus the broiling and roasting of meat and vegetables might be learned even before the ways of kindling fire through percussion and friction had been discovered. But the full art of cooking and the subsequent stages in the reduction of the jaws and teeth in the higher races probably had to await the development of vessels for holding hot water, perhaps in Neolithic times.

This account of the evolution of the food habits of the Hominidæ will probably be condemned by experimentalists, who have adduced strong evidence for the doctrine that "acquired characters" cannot be inherited. But, whatever the explanation may be, it is a fact that progressive changes in food-habits and correlated changes in structure have occurred in thousands of phyla, the history of which is more or less fully known. Nobody with a practical knowledge of the mechanical interactions of the upper and lower teeth of mammals, or of the progressive changes in the evolution of shearing and grinding teeth, can doubt that the dentition has evolved *pari passu* with changes in food habits. Whether, as commonly supposed, the food habits changed before the dentition, or *vice versa*, the evidence appears to show that the Hominidæ passed through the following stages of evolution:

1) A chiefly frugivorous stage, with large canines and parallel rows of cheek teeth (*cf. Sivapithecus*).

3) A predatory, omnivorous stage, with reduced canines and convergent tooth rows (*cf. Homo heidelbergensis*).

3) A stage in which the food is softened by cooking and the dentition is more or less reduced in size and retrograde in character, as in modernized types of *H. sapiens.*

5. APPENDIX A. M. BOULE'S CONCEPTION OF *Eoanthropus* AND OF THE ANCESTRAL HOMINIDÆ.

In the course of a critical discussion of recent archæological and palæontological work in England M. Boule (1915, pp. 60, 62) says of the Piltdown mandible that it completely resembles the mandible of a chimpanzee; that notwithstanding what had been said of it, its molars are more simian than human in type, so that if it had been found alone in the gravel beds of Piltdown, along with the remains of Pliocene mammals, one would not have failed to call it *Troglodytes Dawsoni* and to declare that it gave evidence of the existence in England, during the Pliocene, of an anthropoid ape. But after noting the anatomical difficulties in the way of conceiving this simian jaw as having articulated with a fully human brain-case M. Boule goes on to say that although this purely anatomical argument is not without value, yet it relies too much upon the old Cuvierian doctrine of correlation (il a le tort d'être imprégné d'un vieux parfum cuviérin") and it is based too exclusively upon morphological data drawn from existing human conditions. But, continues M. Boule, palæontologists know how fertile nature is in making unforeseen combinations and she could easily enough associate a human condyle and glenoid fossa with a simian jaw in such a way that the association would not appear absurd either mechanically or physiologically. [To the present writer this argument seems to be almost a *petitio principii.*] It seems that in the evolution of a bony head, when the face diminishes the mandible diminishes more slowly, lagging some distance behind, so to speak, in the retreating movement. This phenomenon appeared very clearly to him, says M. Boule, in both the Chapelle-aux-Saints and the La Terrassie skulls of *Homo Neanderthalensis.*

Passing to the circumstances and conditions of deposition of the Piltdown remains M. Boule (p. 62) notes that it is difficult to imagine the presence, at the same point in the depths of an ancient alluvial formation, of remains belonging to two species of large Primates, and to explain, as a mere chance, the fact that these remains should have the same physical characters, should belong to beings of the same form and should pertain to complementary parts of the skeleton. [This point is critically considered in Dr. Matthew's "Note on the Association of the Piltdown Skull and Jaw" (*postea*, p. 348).

However the chimpanzee jaw may have happened to become associated with the human remains, the fact that it is a chimpanzee jaw is demonstrated, the reviewer believes, by a comparison of the Piltdown mandible with the specimens figured by Miller (See also p. 312 above.).]

On the other hand, continues M. Boule, the presence of an anthropoid in western Europe in the Pliocene epoch would be nothing extraordinary. [In addition to the chimpanzee molar from the Pleistocene of Taubach near Weimar, originally described by Nehring (1895) as a human tooth and identified by Miller as belonging to a chimpanzee, there were chimpanzees in the Pliocene and Upper Miocene of Europe, because a comparison of the molars of *Dryopithecus rhenanus* with those of existing chimpanzees has convinced the reviewer that the former was very closely allied, or even directly ancestral, to the Pleistocene and Recent chimpanzees (*supra*, p. 309).]

So that without rejecting M. Smith Woodward's interpretation, which, says M. Boule, "I believe to be perfectly possible, even probable, it would seem to me prudent for the present to hold the question open and to leave the point of the association of mandible and skull in doubt."

The Piltdown documents, continues our author, are unfortunately incomplete. The interpretation of them is still doubtful on essential points. But for all that they constitute one of the most important and instructive of discoveries. Even supposing that the skull and the mandible be entirely independent yet the fragments of the cranium apprise us of the existence, at a very remote geological epoch, of a hominid with a brain-case essentially human; they show further that this man is connected more distinctly with the line of ascent of *Homo sapiens*, than with that leading to *Homo Neanderthalensis*. The latter would represent, therefore (says M. Boule), as I have long maintained, a very different branch from that of *Homo sapiens*, and hence the point of origin of our direct ancestor should be pushed back very far into the past. Up to the present time one could only cite in support of this fact a small number of discoveries, which were without geological guarantees, without satisfactory legal status, and consequently without any demonstrative value. But here we are in the presence of a fact that is new, thoroughly observed and of clear and precise significance.

The author, after gladly acknowledging the merits of Mr. Smith Woodward's researches, begs his pardon for this final criticism: Why make a new genus for the Piltdown fossil, since according to Mr. Smith Woodward himself, its characters are essentially human, and since he now attributes to it a cerebral capacity as large as that of many existing types? And, especially, why choose the name *Eoanthropus?* Does Mr. Smith Woodward really believe that he has discovered the auroral form of humanity? If, from a palæontological viewpoint, says M. Boule, we compare the evolution of the Hominidæ with that of the Equidæ, we see that the name *Eohippus*, invented by Marsh, corresponds truly to a very ancient Perissodactyl, in which we begin to perceive the tendencies toward the soliped type. Then come other forms: *Mesohippus, Protohippus, Pliohippus* etc., connecting this *Eohippus* with the true *Equus*. Now it is quite certain that *Eoanthropus* does not bear the same relation to *Homo* as *Eohippus* does to *Equus*. It rather represents, for the Hominidæ, about what the *Protohippus* stage does for the Equidæ. And Mr. Smith Woodward, who still retains for the Neanderthal man the name *Homo primigenius*, the incorrectness of which, says M. Boule, I have elsewhere shown, was no better inspired when he devised his *Eoanthropus* for a *Homo*.

Then follows, as a climax and abrupt ending, the conclusion to which all M. Boule's own researches in palæonthropology and palæontology have evidently led him:

Some day, he says, one will discover a hominid of small stature, and almost erect posture, with a brain-case very voluminous in relation to the total volume of the body, but very inferior in absolute value to that of all the Hominidæ now known. And that will be the veritable *Eoanthropus*.

To the reviewer it seems that this striking conclusion, backed as it is by M. Boule's eminent position, and by the high importance of his various memoirs, will be likely to receive a degree of acceptance far greater than that which it truly merits. Unfortunately M. Boule does not enlighten the reader as to his reasons for deriving the Hominidæ from dwarfish beings with swollen heads; but we know that in his memoir on the Chapelle-aux-Saints man he was much impressed by the (to him) profound differences in the structure of the limbs between this ancient Hominid and all known Anthropoids, so that he finally ascribed many of the resemblances between the two groups to a far-reaching parallelism, extending even to blood reactions, brain structures and characteristics ordinarily regarded as indicative of a common origin. We know too that in that memoir he finally suggested that the point of divergence between the Hominidæ and other Primates might prudently be regarded as occurring very far down upon the Primate stem, perhaps even before the divergence of the lemurs from the remaining Primates and he insisted that the poverty of the palæontological record must render nugatory any attempt to work out the phylogeny of the Hominidæ from existing data.

The reviewer on the contrary has maintained (*vide supra*) that even if we had no direct palæontological evidence, the data of comparative anatomy are sufficient to demonstrate that the anthropoid apes are the nearest existing relatives of mankind; that the divergence of the Hominid branch occurred not in a pre-lemuroid or even pre-catarrhine stage, but from the anthropoid stem after the separation of the gibbons; further, that from the palæontological side the fundamental unity in premolar and molar patterns between Tertiary anthropoids and Quaternary Hominidæ reinforces the anatomical evidences for unity of origin of these groups. The reviewer is also of the opinion that the enlarged braincases of certain small-bodied lemuroids and platyrrhines and of human fœtuses offer no real evidence that the ancestral hominid had a swollen braincase. As for the swollen head of the human fœtus that is evidently a cænogenetic character, as it is in many other mammals. The reviewer also holds that the anatomical and palæontological data give evidence of a profound change of function and structure in the human dentition, a change from a pre-human frugivorous stage to a sub-human omnivorous-carnivorous stage; that the immediate ancestors of the Hominidæ, after the loss of the chief anthropoid characters were of large size, powerful build and predatory habits and that the bipedal adaptations were assumed at a relatively late geological epoch (Middle Tertiary).

6. Appendix B. Note on the Association of the Piltdown skull and Jaw.

By W. D. Matthew.

The finding of the cranial fragments and lower jaw associated in the same stratum and locality, and in similar state of preservation, has been presented as an argument for their pertaining to the same individual. Curiously enough this evidence has been discussed and weighed with purely theoretical and *à priori* reasons, as though it were a unique case in palæontologic discovery. But it is a very common occurrence among fossil mammals. Every collector, every cataloguer of such collections must have had again and again to decide whether a "lot" of fragments found together represented one individual or more than one, and what parts should be assigned to each if two or more animals were present. In the experience of the American Museum collecting there have been thousands of such cases to decide, and the probabilities and methods of determining them are well known and have been thoroughly tested. The conditions of discovery vary between extremes in which all the remains belong certainly to a single individual, and the so-called "general quarries" and miscellaneous pots in which remains of many individuals are commingled, often with no probable association of parts. For the most part the extent to which the animals represented can be sorted out, and the degree of probability that attaches to the association of different parts as of the same individual, must be decided by the particular circumstances in each case. Few general rules can be laid down. Duplication of parts affords of course conclusive proof of the presence of more than one individual. The presence of parts recognized as belonging to different kinds, ages or sizes of animals, proving that more than one individual is represented casts doubt upon the pertinence to a single individual of bones which would otherwise be associated with reasonable probability. Such associations must be scrutinized with care. The mere fact that they are found together, and are anatomically proven to belong to the same order or even genus, has but little weight as evidence for pertinence to one individual. Yet if numerous fragments of different parts which might be tentatively assigned to a single animal are found to fit together in part, there will be good reason to conclude that the lot of fragments is mainly of one individual and only a few odd bones of others have become intermingled. If, on the other hand, a lot of fragments are found together which may reasonably belong to a single individual, and there is no evidence at all of any intermixture, the lot being found well separated from any other fossil remains, there is a high degree of probability that they do all belong together; and this probability is higher in proportion to the number of bones or fragments present.

If the Piltdown remains were subjected to the ordinary practical criticism with regard to their association that would be accorded to any lot of fossil mammals for cataloguing and record at the American Museum, or any similar institution, the question of association would turn largely upon the foregoing considerations.

It would be clear in the first place that there is unquestionable evidence of admixture of animals belonging to different groups. The teeth or fragments of *Stegodon, Mastodon, Hippopotamus* etc. are stated to be found in the same deposit; it is a gravel deposit, and this is well known to add greatly to suspicion of intermixture. Some of the remains are stated to be in a rolled and water-worn condition presumably derived from an older deposit, others including the primate remains, *Hippopotamus, Castor* and *Cervus* are considered to be of the same age as the gravel. The latter are then unquestionably a mixed lot, and the mere association has little weight as evidence that all the primate remains belong to one individual. So far as the cranial fragments are concerned, some of them are found to fit together; this is strong positive evidence that all the cranial fragments belong to one individual, and as all are characteristically identical with the genus *Homo,* it may be accepted as a practical certainty that they do belong together. The fragments of nasal bones may, but with somewhat less certainty, be assigned to the same individual. If various parts or fragments of the skeleton were present, I should regard it as strong presumptive evidence for associating the lower jaw with the skull. In the absence of any skeleton fragments no such presumption exists. There is not much more probability that the lower jaw would remain in association with the skull than that any of the other bones of the skeleton would so remain. Theoretically there should not be any more, but in practice one finds the skull more often associated with the lower jaw than with any particular skeleton bone. There is therefore more probability that a primate skull and jaw found associated would pertain to the same individual than that a primate skull and ulna found together would be from the one animal. But in neither case is the probability of very high degree, unless there is an entire absence of admixture of remains of any other animals, which in this instance is not the case.

The canine tooth if it belongs to the upper jaw does considerably add to the probability of the association with the skull, provided it were evident from the freshness of the root surfaces that it had been buried in the alveolus up to the time that the cranium was broken in fragments. Otherwise it has little weight. If it were, as Doctor Smith Woodward considers it to be, a lower canine, it would not afford any confirmatory evidence for association of skull and jaw.

In brief, a critical consideration of the available evidence for association of the primate remains from Piltdown, on the same lines that have been used in associating the thousands of more or less similar Tertiary mammal specimens that I have had occasion to examine for cataloguing purposes, would lead to the conclusion that they may probably represent either one or three individuals, but that they might be tentatively associated as of one individual provided they belonged to a single known type or that no anatomical discrepancies or improbabilities were involved. But the argument from association is quite too slight to outweigh any such contrary evidence, and certainly not adequate to base upon it the erection of a new type of primate combining characters hitherto found dissociated in distinct generic types.

This opinion is based solely upon examination of the casts and of the published evidence. I do not question that much additional evidence would appear upon a critical examination of the original specimens, and it is stated with due deference to the judgment of those who have had that privilege. I think proper to express it only because I have had somewhat exceptional opportunities of examination and judgment upon a great number of cases which I deem to be more or less similar.

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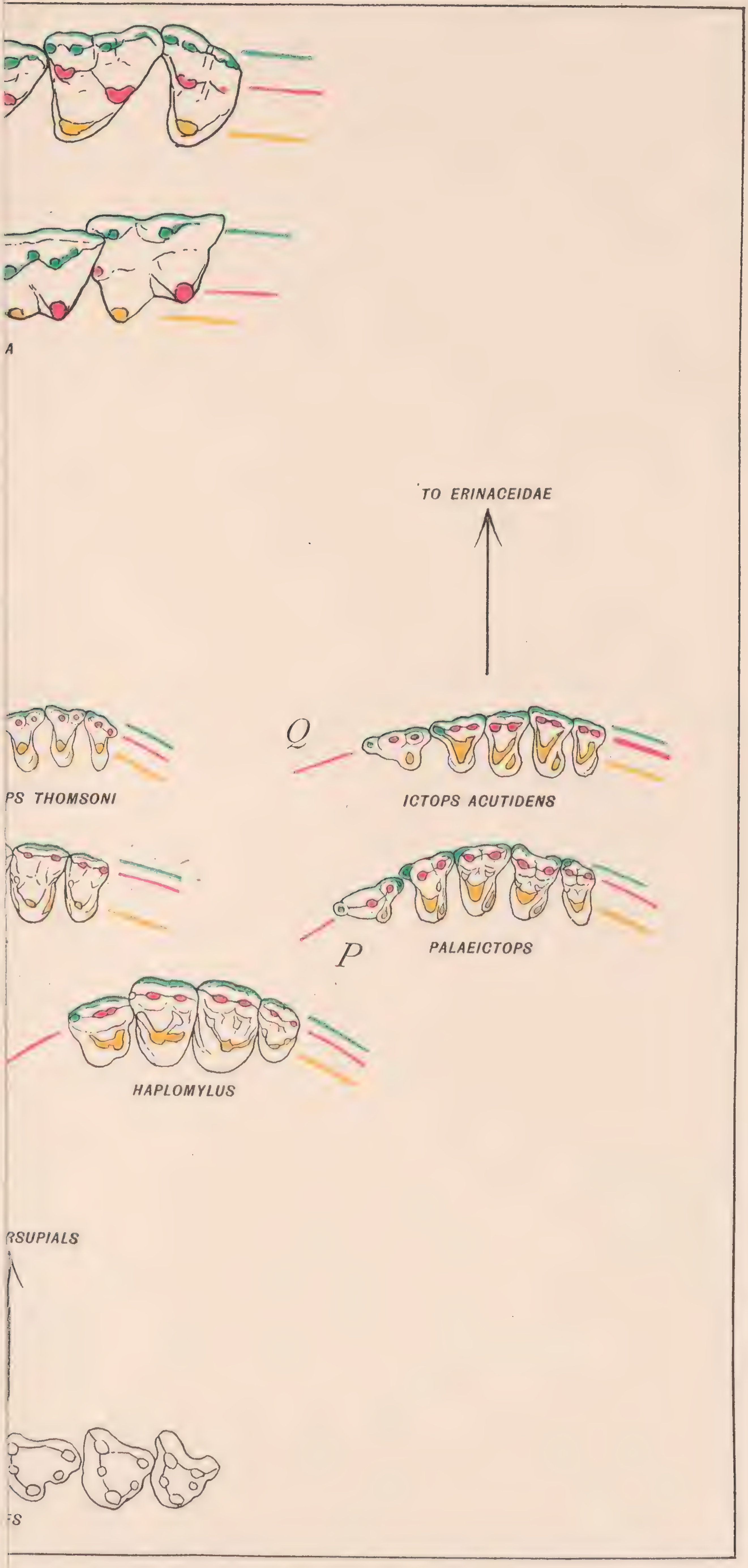
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(Continued from 3d page of cover.)

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Article XX.— PANAMA MAMMALS COLLECTED IN 1914–1915.

By H. E. Anthony.

With Map.

During 1914 and 1915 several collections of mammals and birds were made in Panama by the American Museum of Natural History. Although very little of the mammal material proved new to science, a list of the species, with such notes as seem to be of interest, is deemed worthy of record, as the region is faunally an important one, connecting in some respects the fauna of Central America with that of South America.

Mr. E. A. Goldman, of the United States Biological Survey, detailed to work for the Smithsonian Institution in Panama, made extensive collections there in 1911 and 1912, and the material collected by the American Museum is in part a duplication of Mr. Goldman's work. Since he has described many new forms from Panama, and has ready for the press a complete report on all the mammals of Panama, this list is made as brief as possible. Through the kindness of Mr. E. W. Nelson, Acting Chief of the Biological Survey, and of Mr. E. A. Goldman, I have had the opportunity of comparing the American Museum series with those of Goldman's at Washington. I also wish to acknowledge indebtedness to Mr. Goldman in this connection for his help and advice in making these comparisons. Most of the identifications of species were made by direct comparison with Goldman's specimens. As he had previously worked up his collection in detail, his names are used provisionally without verification. Any credit due the Darien Expedition of the American Museum must be shared with Mr. Wm. B. Richardson of Matagalpa, Nicaragua, and Mr. D. S. Ball of this museum because of their hearty assistance in the field, without which the material results of the expedition would have been greatly reduced. Finally the author wishes to express his deep appreciation of the advice and help given him by Dr. J. A. Allen, Curator of the Department of Mammals and Birds.

In February and March, 1914, through the generosity of Mr. George Shiras 3rd, I was enabled to collect mammals in the Canal Zone of Panama for the American Museum. In consequence of the limited time spent in the field the collection was not very large and was made mainly at points in the Zone most readily accessible.

In October, 1914, the Museum sent Mr. Wm. B. Richardson into eastern Panama where he collected mammals and birds in the lowlands until February, 1915, when the author, accompanied by Mr. David S. Ball of the department of birds in the American Museum, joined Mr. Richardson at Panama City. Here the party outfitted and, February 8, took a launch to El Real on the Tuyra River. The outfit was then transferred to canoes and the river ascended to the limit of canoe navigation at Tapalisa. Here Mr. Richardson remained for several weeks while Mr. Ball and I took packers and proceeded up into the cordillera to the old Indian village of Tacarcuna where collecting was carried on at an elevation of about 2600 feet. Late in March a still higher camp, about 5200 feet above sea level and approximately the highest continuous country attained, was made on the slopes of Mt. Tacarcuna. Returning to the lowlands the middle of April to establish new collecting sites we were caught by the rainy season and forced to abandon work at the higher elevations. Mr. Ball and the author returned to New York with the material then on hand while Mr. Richardson spent the latter part of April and the month of May collecting at Cituro and Boca de Cupe, in the lowlands.

Topography.

Eastern Panama has a varied topography. On the Pacific side the land is very low and heavily forested with dense tropical jungle. This whole general region is drained by the Tuyra River, a drowned river up which the tide ascends about 70 miles to Pinogana, just above El Real. At its mouth the river has a width of about five miles, and although allowance must be made for the volume of the river being increased by the tide-waters of the Pacific, the amount of fresh water discharged is very considerable. Above the head of tide-water the river ascends by gradual stages until the rapids and shoals are encountered, just below Boca de Cupe. From here up to Tapalisa, on the Rio Pucro, the river has more fall and is difficult to ascend with a large canoe. The character of the country remains the same from San Miguel Bay to Tapalisa, mainly flat, with low, rolling, forested hills.

At Tapalisa an elevation of 1000 feet is reached and here the first line of foothills of the cordillera are met. The trail from Tapalisa to Tacarcuna begins to rise after an hour out, and from then on the country is very steep and mountainous. The ridges run in long parallel series and are terraced off by the intervening ravines in rises of about 1000 to 2000 feet. Everywhere the same heavy forest and undergrowth flourishes, and is so thick that only occasionally may one see any distance from the crest of a high ridge. The mean elevation of the main ridges is about 3500 feet, and their direction is roughly north and south.

At Tacarcuna, an old Indian village (deserted most of the time), the trail

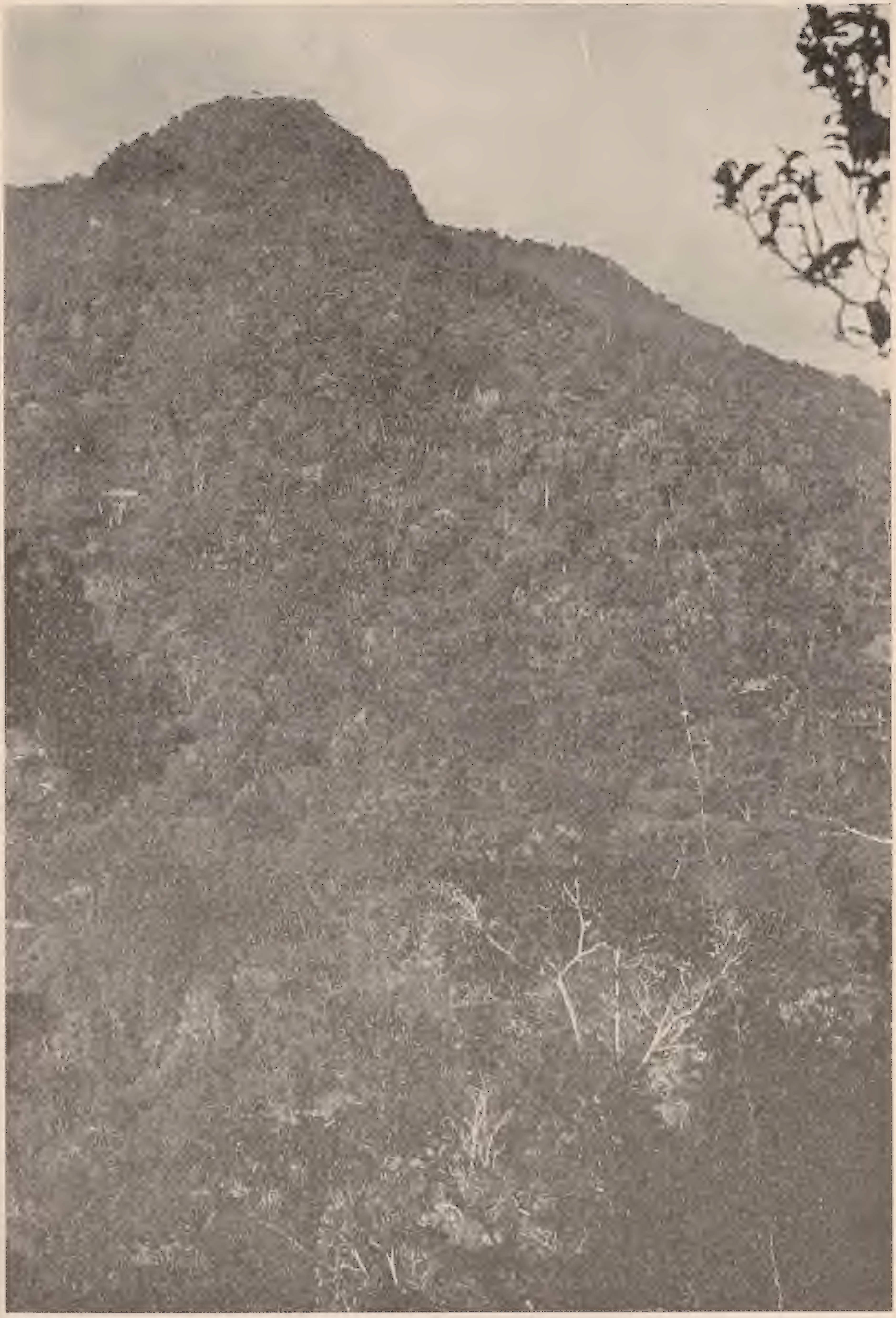

Fig. 1. Summit of Mt. Tacarcuna.

strikes the headwaters of the Rio Tapalisa. Here there are no level areas of any extent; the ridge crests are narrow and the slopes often precipitious to perpendicular. At this point the cordillera has been penetrated but the highest as well as the most eastern range is not met with until about five or six miles from Tacarcuna. Mt. Tacarcuna, with an elevation of 5650 feet by barometer, rises from this last range which has its crest at no point much below 5000 feet. To the eastward the land falls rapidly away and the level of the sea is reached in apparently but one or two descents. The line of foothills that extend to the westward of the main range has no counterpart on the east. From the last ridge on the east we could see a large body of water with a stream entering it that we judged must be the Gulf of Darien and the Atrato River.

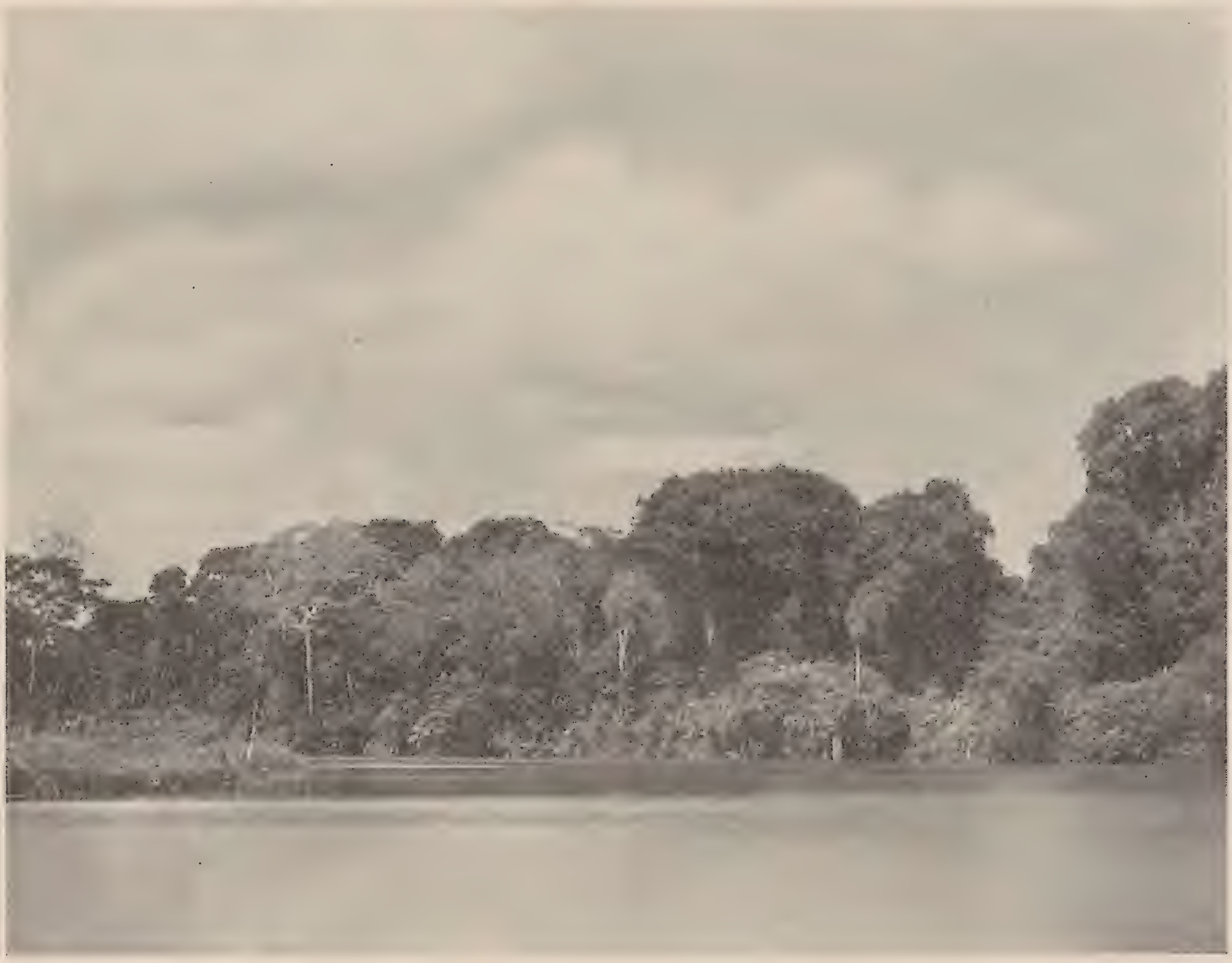

Fig. 2. Rio Tuyra at El Real.

The character of the forest growth remains the same eastward from the mouth of the Tuyra until an elevation of about 4500 feet, on the slopes of Mt. Tacarcuna, is reached. The density of the growth decreases with the

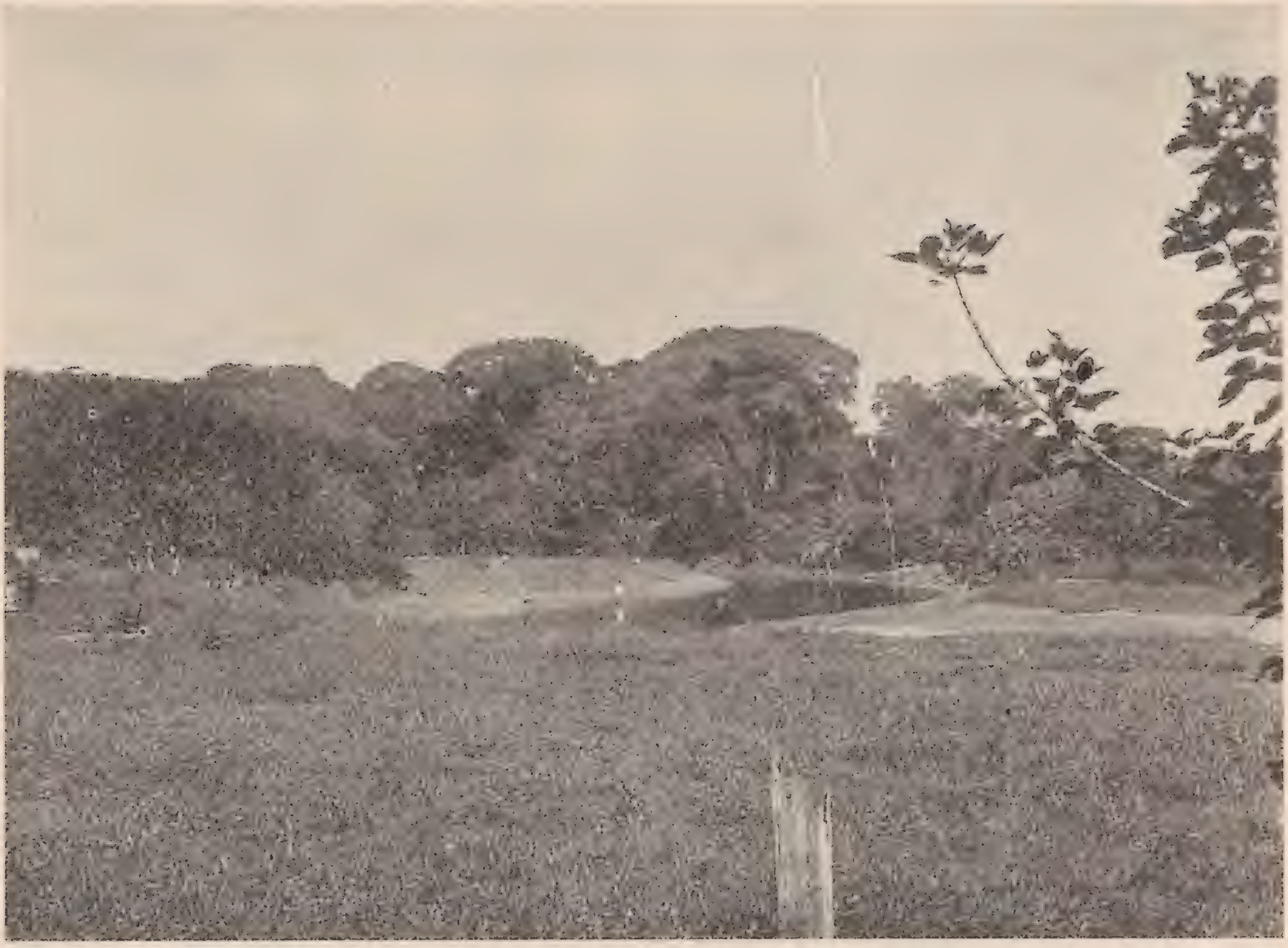

Fig. 3. Rio Pirri at El Real.

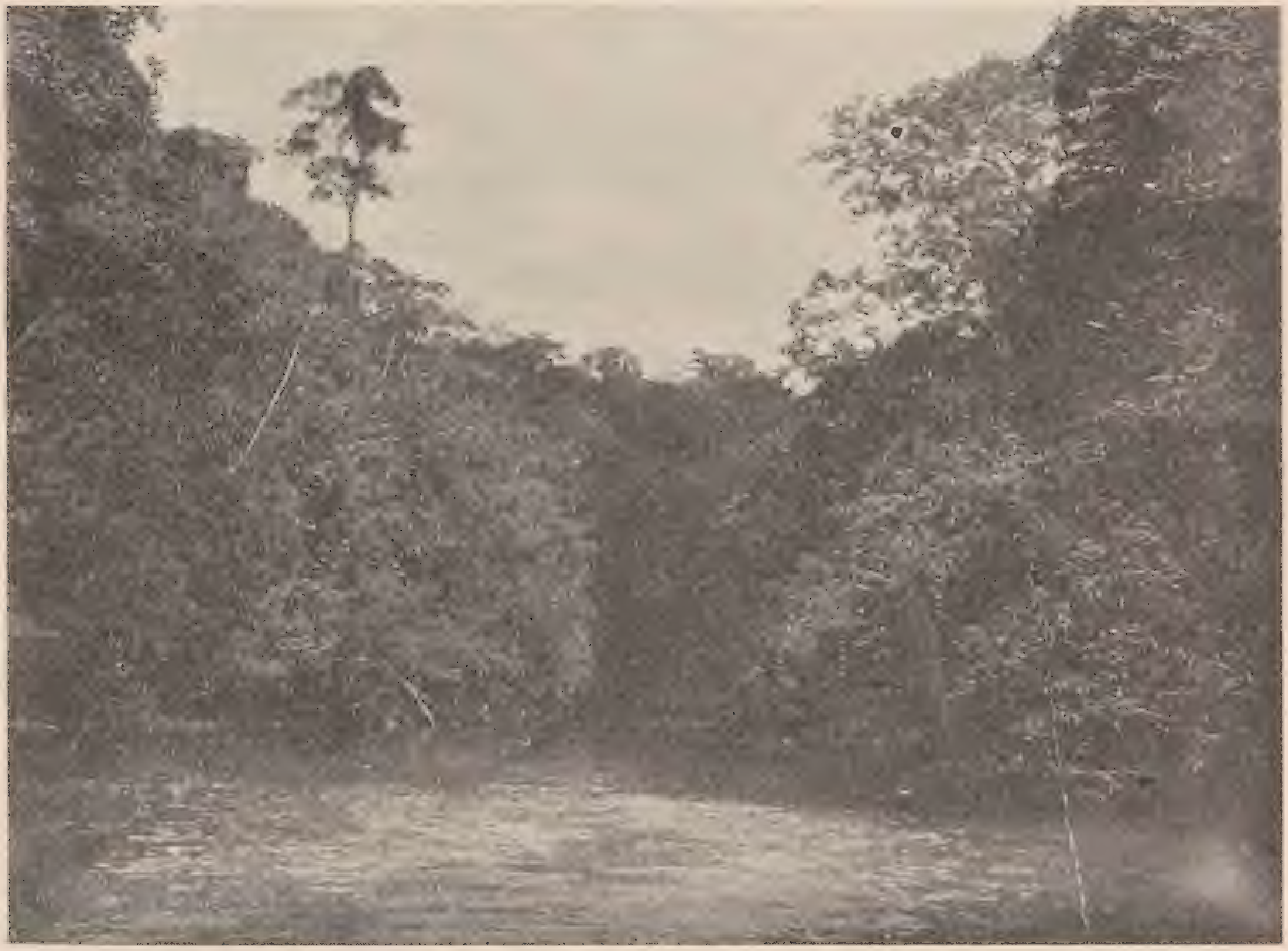

Fig. 4. Rio Pucro below Tapalisa.

rise in elevation but at the mountain a different type of forest is found. The growth is neither so heavy nor the trees so large as in the lowlands and it is evident that a new floral zone has been entered. Here a variety of tree ferns grow, but when an elevation of 5000 to 5500 feet is reached the appearance of the forest is much like that of northern forests of hard woods and birches. The heavy growth of the lowlands penetrates in favorable gulches up into the higher zone to about 5000 feet.

Mt. Tacarcuna itself is a steep conical peak that rises about 800 feet from the main range. Its slopes are strewn with great blocks of stone, of a basaltic nature as nearly as could be ascertained for lichens and other vegetation clothed the rocks so densely that their determination was difficult, and its summit is overgrown with a dense, exceedingly hard-wooded shrub that made progress almost impossible. Mists continually sweep over it and it is

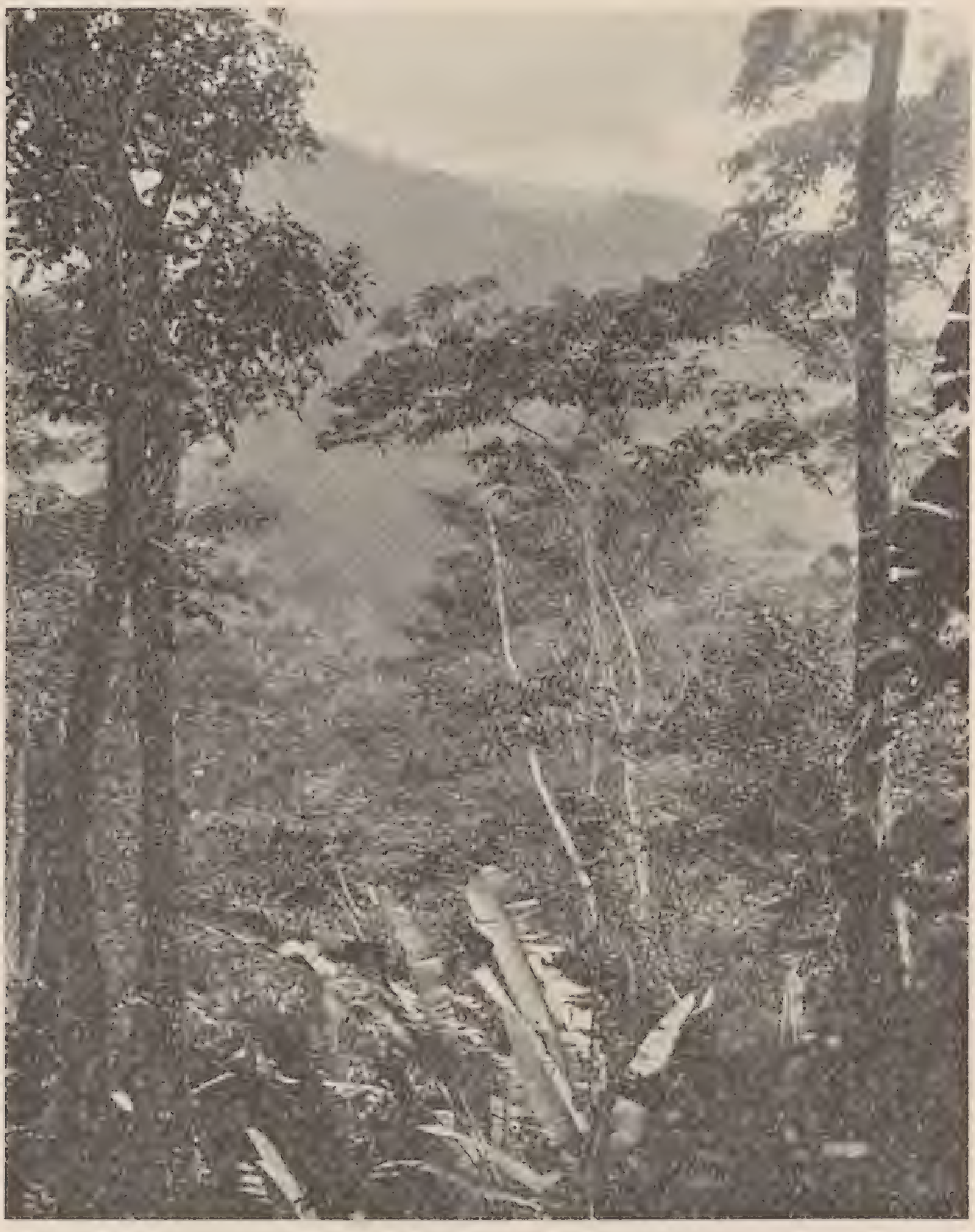

Fig. 5. Cordillera near Tacarcuna.

seldom that a complete view of the surrounding country may be obtained from the peak. The ridges as far as the eye can reach, not a very great distance in the Darien, are continuous and extensive, forming a serrated highland of considerable area with a north and south trend. These ridges, at some points, look to be at least as high as Mt. Tacarcuna, if not higher, and probably the maximum height of the Darien Cordillera is not very far from 6000 feet.

The main valleys of this high country are drained by rivers of clear, fairly cool water, which descend over rocky beds with a decided fall. When one leaves these few main streams, although the forests drip with water and the atmosphere is saturated with moisture, springs that come to the surface are almost unknown and the traveller has difficulty in securing enough water to drink. In the height of the rainy season the surplus water is carried off down the steep slopes by little gulches which scar the mountain sides.

High winds pass over the cordillera and numerous uprooted trees are the result. The rainy season usually sets in late in April and then the trails become slippery and impassable to men with packs.

This is a region of noticeable seismic activity, a very vigorous quake that brought down debris from the trees, and was accompanied by a heavy rumbling like distant thunder, was experienced March 29.

Systematic List.

1. **Marmosa isthmica** *Goldman.*

A large series of murine opossums was taken, and includes localities from both low and mountainous regions. This series is identical with Goldman's type and with specimens taken near Mt. Pirri. There is no appreciable difference between those from sea level and those from 4000 feet elevation. The males are much larger than the females.

Specimens collected, 48.— El Real, 4; Gatun, 7; Maxon Ranch (Rio Trinidad), 2; Tapalisa, 2; Tacarcuna, 2650 feet to 4200 feet, 33.

2. **Metachirus fuscogriseus fuscogriseus** *Allen.*

This species was encountered but once, at Gatun, and the specimen agrees in all particulars with the type of *fuscogriseus* from Central America.

Specimens collected, 1, from Gatun.

3. **Metachirus nudicaudatus dentaneus** *Goldman.*

A small series of this yellow brown opossum, taken in the Canal Zone and in the Darien, conforms well with Goldman's type from Gatun.

Specimens collected, 8.— Gatun, 3; Maxon Ranch (Rio Trinidad), 3; Tacarcuna, 2.

4. **Didelphys marsupialis etensis** *Allen.*

This large opossum was found to be not uncommon in the Canal Zone but was rather rarer in the Darien district.

Specimens collected, 8.— Boca de Cupe, 1; Cituro, 1; El Real, 1; Gatun, 5.

5. **Bradypus ignavus** *Goldman.*

The type locality of *ignavus* is Marraganti, and the sloths collected by these expeditions were none of them taken at a distance from Marraganti greater than 30 miles or at an altitude exceeding that of Marraganti by more than a few hundred feet. However my specimens are quite different from Goldman's *ignavus*, being much darker in tone throughout; the browns are stronger, reaching a decided chocolate color, the whites are quite yellow instead of clear white as in the Marraganti specimen. Moreover the series of four adults are uniform in these characters. Under the conditions it seems advisable to call my specimens *ignavus* on the assumption that individual variation or color phase will bridge over these marked differences.

Specimens collected, 5.— Cituro, 1; El Real, 3; Tapalisa, 1.

6. **Bradypus griseus** (*Gray*).

A sloth, sent to the Museum by Mr. Fred Huber of Gatun, is referable to this species. No others were taken.

Specimens collected, 1, from Gatun.

7. **Tamandua tetradactyla chiriquensis** *Allen.*

This ant-eater was seemingly rare as but two specimens were secured.

Specimens collected, 2.— Chepigana, 1; Maxon Ranch (Rio Trinidad), 1.

8. **Pecari crusnigrum** (*Bangs*).

This species was found to be generally distributed throughout the Zone as well as the mountains to the southeast. Animals collected in both regions are referred to *crusnigrum* from Chiriqui.

Specimens collected, 5.— El Real, 2; Gatun, 3.

9. **Tayassu pecari** (subsp. ?).

Natives reported this animal as not uncommon, and a small band supposed to be this species was encountered along the cordillera at about 5000 feet elevation but no specimens were secured.

10. **Mazama sartorii reperticia** *Goldman.*

The brocket deer was taken in southeastern Panama where it seemed to be fairly common. Dr. Allen has identified the specimens as the above subspecies.

This deer was exceedingly wary and hard to shoot. Many were heard when frightened by our passage along the trails but it was very unusual to see one. In addition to those collected, this species was noted at Tacarcuna at elevations from 3000 to 4500 feet.

Specimens collected, 11.— Boca de Cupe, 1; Chepigana, 1; Cituro, 1; El Real, 4; Maxon Ranch (Rio Trinidad), 1; Tapalisa, 3.

11. **Tapirella bairdi** (*Gill*).

Although no specimens of tapir were secured, tracks of this species were noted frequently in the Canal Zone and on the slopes of Mt. Tacarcuna.

12. **Mesosciurus gerrardi morulus** (*Bangs*).

Squirrels taken at Gatun are referrable to *morulus* of Bangs, type locality Loma del Leon, Panama. *Morulus* was not taken elsewhere but in a large series of *choco* taken in eastern Panama, a specimen from El Real and another from Tapalisa show marked intermediate characters between *morulus* and *choco,* and if taken singly, with none of the darker individuals, would have to be called *morulus.*

Specimens collected, 3, from Gatun.

13. **Mesosciurus gerrardi choco** (*Goldman*).

This black-backed subspecies was found quite generally distributed throughout southeastern Panama, although nowhere did it seem to be as common as the squirrels of northern woods. The series bears out Goldman's description of the type from Cana. The characters which separate it from *morulus,* while variable, as would be expected, are in most cases readily apparent.

Specimens collected, 35.— Boca de Cupe, 4; Chepigana, 4; Cituro, 6; El Real, 7; Tacarcuna (altitudes from 2650 to 5200 feet), 12; Tapalisa, 2.

14. **Microsciurus alfari venustulus** *Goldman.*

The pygmy squirrels collected in Panama seem to fall into two groups separated from one another by distinct although somewhat variable characters. The series of six specimens can be divided by color characters; they were all collected in the same general locality but *venustulus* was taken at slightly higher elevations and on the crest and eastern slope of the cordillera. Three of the specimens agree closely with the type of *venustulus* from Gatun.

These squirrels were very rare and were very hard to secure although the natives told me they saw them quite frequently. One that was observed displayed much the same habits as those of the northern chickaree, scolding in a harsh, husky fashion and jerking the tail emphatically.

Specimens collected, 3.— Mt. Tacarcuna (5200 feet altitude), 3.

15. **Microsciurus isthmius vivatus** *Goldman.*

Squirrels collected out from the old village of Tacarcuna are referable to *vivatus,* described from Cana, but they also resemble *isthmius* Nelson to a marked degree.

Specimens collected, 3, all from Tacarcuna, 2650 feet altitude.

16. **Peromyscus (Megadontomys) pirrensis** *Goldman.*

The commonest rat of southeastern Panama is the big *pirrensis* of Goldman. It was not taken at elevations below 2650 feet but ranges from somewhere about this altitude up to the crests of the cordillera, 5200 feet. A large series was taken at the old village of Tacarcuna and at intermediate points up to Mt. Tacarcuna. It was trapped everywhere throughout the forest of this region.

Specimens collected, 50.— All from the Tacarcuna region from 2650 feet to 5200 feet altitude.

17. **Tylomys fulviventer** sp. nov.

Type No. 38063, ♀ adult, Tacarcuna, District of Darien, Panama. Alt. 4200 ft. March 13, 1915. Collector H. E. Anthony.

Similar to *watsoni* of Thomas but differing markedly from it in color.

Color above argus brown of Ridgway becoming darkest toward the rump, with some admixture of darker, almost black, hairs. Sides lighter in tone than the back; fore and hind limbs above the same color as adjacent parts. Hands and feet dusky above, the toes but very little lighter than the metapodials. Bases of hairs everywhere above slate gray. Head with same general coloration as sides of body and with the dark color of the back extending somewhat in advance of the ears.

Color below unique; a median line from 3 to 8 mm. wide, from pectoral region to base of tail, russet; area between this line and the darker color of the sides ochraceous-buffy; throat varying from warm buff to light ochraceous buff; base of tail auburn. Hair of mid-underparts unicolor to base. Under side of limbs with median encroachments of the lighter color of adjacent parts.

Tail for basal half black, somewhat grayer below; terminal half, in flesh, clear white, in dried skin, pale yellowish white.

Skull characters the same as for the genus. Compared with adult *watsoni*, *fulviventer* has the skull with longer incisive foramina, reaching back to plane of first molars. Nasal-premaxillæ suture with frontals convex, the nasals extending posteriorly beyond the premaxillaries.

Measurements.— Total length, 451; tail vertebræ, 233; hind foot, 38; all from animal in the flesh. Skull, total length, 51; zygomatic breadth, 25; nasals, 19; palatal length, 205; maxillary toothrow, 8; incisive foramina, 10.

Mammæ 4, inguinal.

Specimens examined: 1, the type.

It is rather surprising to find an apparently undescribed *Tylomys* in Panama whence two species, *watsoni* and *panamensis* have already come. However the specimen from Mt. Tacarcuna differs so much in coloration from either of the above species that it seems evident from the material on hand and from the literature on the genus that it is entitled to full specific rank. Scarcity of specimens of this genus and the impossibility of deciding with certainty the status of *panamensis* Gray without examination of the type create rather unsatisfactory conditions. Compared with specimens of *watsoni* from Chiriqui, Panama, the rich warm coloring of *fulviventer* is alone a sufficient distinction, while the character of the nasals is much different in the two forms, the nasals of *fulviventer* being longer than the premaxillaries, those of *watsoni* " decidedly surpassed by the premaxillæ " (Thomas). The feet of *fulviventer* have toes of approximately the same shade as the metapodials but in *watsoni* the " whole of the digits [are] white " (Thomas). *Panamensis* is described as white-bellied, and the only material for comparison available, an immature specimen from Talamanca, Costa Rica, has white underparts and the same general coloration as *watsoni*. Compared with two specimens of *nudicaudus* Peters from La Carpintera, Costa Rica, and from Nicaragua, somewhat the same coloration above is noted but here again, as far as may be determined from the fragmentary specimens and from Peters' original description,[1] the white underparts prove the distinctness of *fulviventer*; and furthermore *nudicaudus* has the digits white, contrasting noticeably with the dark metapodials.

The possibility that the peculiar color of the under parts is due to stain must be taken into consideration but this seems unlikely because the brown hairs are in too definite arrangement and are correlated with the strong brown color of the upper parts. A stained specimen of *watsoni,* for example, it seems fair to believe, would not resemble *fulviventer.*

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[1] Peters — Monatsb. Akad. Wissens. Berlin, 1866, p. 404.

This rat was taken in a banana-baited trap set at the foot of a large tree in the fairly heavy forest that clothes Mt. Tacarcuna. Although the locality was diligently trapped for more, none were taken. A rat thought to be this species was smoked out of a hollow tree, together with a few bats, but it escaped into a hole before it could be secured.

18. **Sigmodon borucæ chiriquensis** *Allen.*

This rat was taken only at Gatun where it was found in a low grassy meadow near the Chagres.

Specimens collected, 1, from Gatun.

19. **Zygodontomys cherrei ventriosus** *Goldman.*

This species was found but rarely. It was taken only at low elevations.

Specimens collected, 6.— El Real, 1; Gatun, 4; Old Panama, 1.

20. **Oligoryzomys costaricensis** *Allen.*

Two small mice from the savannas of Old Panama are referred to *costaricensis,* proving to be indistinguishable from a series of this species taken at Boqueron, Panama.

Specimens collected, 2, from Old Panama.

21. **Oryzomys pirrensis** *Goldman.*

This large *Oryzomys* was taken only at the upper camp on Mt. Tacarcuna, 5200 feet altitude. It did not appear to be common as but six specimens were secured. Externally this species bears such a strong resemblance to the *Megadontomys* so common throughout the whole region that it required the closest examination of the animals in the flesh to separate them. The more buffy parts of this *Oryzomys,* together with a more naked and more finely annulated tail, and shorter whiskers, serve as the best field characters.

Specimens collected, 6, from Mt. Tacarcuna.

22. **Oryzomys alfaroi dariensis** *Goldman.*

A single immature specimen of this species, seeming to agree satisfactorily with Goldman's series from the Pirri region, was trapped on Mt. Tacarcuna.

Specimens collected, 1, from Mt. Tacarcuna.

23. **Oryzomys frontalis** *Goldman.*

One specimen, taken at the old Indian village of Tacarcuna is referred to *frontalis*.

Specimens collected, 1, from Tacarcuna.

24. **Oryzomys talamancæ** *Allen.*

This soft-haired *Oryzomys* was found sparingly throughout the lowlands from the Canal Zone to the Darien. These specimens differ apparently in no material details from the type taken at Talamanca.

Specimens collected, 15.— Cituro, 1; El Real, 1 ? (quite young); Maxon Ranch (Rio Trinidad), 3; Tacarcuna, 1; Tapalisa, 9.

25. **Melanomys idoneus** (*Goldman*).

The dark *Melanomys* was found to be quite common in the clearing at the old village of Tacarcuna, but seemed rather rare at lower elevations. It was not found at elevations above 4200 feet. Animals from sea level in the Zone are not appreciably different from those taken at Tacarcuna. These specimens are identical with *idoneus* of Goldman but are also very much like *chrysomelas* Allen from Costa Rica.

Specimens collected, 29.— El Real, 2; Gatun, 1; Maxon Ranch (Rio Trinidad), 3; Tacarcuna, 23.

26. **Nectomys alfari efficax** *Goldman.*

This species was found to be fairly common at Tacarcuna but, strangely was not taken elsewhere.

Specimens collected, 15, all from Tacarcuna, 2650 feet elevation.

27. **Neacomys pictus** *Goldman.*

Two of these small spiny mice, taken at Tacarcuna, are identical with the type of Goldman's *pictus*. The genus was not encountered elsewhere.

Specimens collected, 2, from Tacarcuna.

28. **Macrogeomys dariensis** *Goldman.*

The large black pocket-gopher was first encountered at Boca de Cupe. It was not found in the Canal Zone nor on the crest of the cordillera, the highest " earths " noted being at about 4200 ft.

Specimens collected, 9.— Boca de Cupa, 3; Tacarcuna, 5; Tapalisa, 1.

29. **Heteromys zonalis** *Goldman.*

A single specimen taken on the lower Rio Trinidad at the Maxon Ranch proves to be *zonalis* described from a specimen taken near Gatun, about 25 miles distant.

Specimens collected, 1, from Maxon Ranch (Rio Trinidad).

30. **Heteromys crassirostris** *Goldman.*

A *Heteromys* taken on Mt. Tacarcuna at an elevation of 5200 feet, upon comparison with Goldman's material, is referred to *crassirostris.*

Specimens collected, 1, from Mt. Tacarcuna.

31. **Isothrix darlingi** *Goldman.*

Two specimens of this rare rat were collected by Richardson near Tapalisa. They were frightened from a hollow tree and he shot them as they were running along the limbs, the animals falling into the river from the overhanging tree when shot.

Specimens collected, 2, near Tapalisa.

32. **Proechimys centralis panamensis** *Thomas.*

This spiny rat was quite abundant at low elevations, less so at higher points and none were taken on the crest of the mountain range.

Specimens collected, 46.— Boca de Cupe, 3; Cituro, 5; El Real, 8; Gatun, 21; Maxon Ranch (Rio Trinidad), 3; Tacarcuna (2650 feet altitude), 3; Tapalisa, 3.

33. **Hoplomys goethalsi** *Goldman.*

The *Hoplomys* taken at Gatun is topotypical of *goethalsi,* and those taken at other points differed in no respects from the Gatun individuals.

Specimens collected, 8.— Gatun, 2; Tacarcuna (2650 feet altitude), 6.

34. **Dasyprocta isthmica** *Alston.*

Agoutis were collected both in the Zone and in the Darien region up to about 800 feet elevation. A specimen taken on the lower Rio Trinidad, about 20 miles from Gatun and about 25 miles from Colon, the type locality of *isthmica,* is assumed to be typical (a topotype), and is indistinguishable from the series taken in the Darien.

Specimens collected, 9.— Boca de Cupe, 3; Chepigana, 2; Cituro, 1; El Real, 2; Maxon Ranch (Rio Trinidad), 1.

35. **Hydrochœrus isthmius** *Goldman.*

The capybaras collected on the Rio Tuyra, the only place where this animal was encountered, are practically topotypical, as Marraganti, the type locality of *isthmius,* is but two miles from El Real.

36. **Sylvilagus gabbi gabbi** *Allen.*

A specimen taken near the ruins of Old Panama differs noticeably from specimens of *gabbi* taken by Goldman in the Canal Zone, in the heavily forested section. The Panama individual came from the savanna region and is lighter in color throughout. The chestnut of the top of the head is weaker in tone and with no intermixed black hairs, and the sides of the head also lack the black hairs of *gabbi* from the forests. It appears somewhat as if the savanna country was inhabited by a race of the forest species, having lighter coloration as the principal character. However the material available is not sufficient to warrant any definite conclusions and until more is acquired the name *gabbi* will be best applicable to this specimen.

Specimens collected, 1, from ruins of Old Panama.

37. **Sylvilagus gabbi messorius** *Goldman.*

Compared with the type series from Cana, the specimens collected by the American Museum match *messorius* very closely, as would be expected on geographical grounds.

Rabbits were not very common, the few that were taken being trapped in runways or brought in by natives.

Specimens collected, 9.— Boca de Cupe, 3; Tapalisa, 4; Tacarcuna, 2.

38. **Panthera onca centralis** (*Mearns*).

One specimen shot near Boca de Cupe by an Indian hunter, seems, upon comparison with the type of *centralis,* a skull from Talamanca, Costa Rica, to be *centralis.* The Talamanca skull is much larger than that of the Panama specimen but the former is an old male while the latter is younger and probably a female. Compared with the type skin of *hernandezi goldmani* from Campeche, Mexico, the Panama cat has larger spots, especially on the head, but is otherwise very similar.

Specimens collected, 1, from Boca de Cupe.

39. **Oncoides pardalis mearnsi** (*Allen*).

The smaller cats were found to be rather rare in the Darien, if judgment may be based upon specimens taken, for but one animal was secured.

Specimens collected, 1, from El Real.

40. **Nasua narica panamensis** *Allen.*

The nasua taken in southeastern Panama is *panamensis*, the type locality being Boqueron, Panama.

Specimens collected, 8.— Boca de Cupe, 1; El Real, 1; Tacarcuna, 2; Tapalisa, 4.

41. **Potos flavus chiriquensis** *Allen.*

The kinkajous collected in southeastern Panama, none being taken in the Canal Zone, comprise a series with considerable range in color variation, from individuals with a lively ochraceous tone on the flanks and underparts, to those with a much flatter tone of yellow buff. The color of the upperparts also varies considerably in much the same manner.

Two were taken from a hollow tree at Tacarcuna, two were shot by moonlight and with the jack light at the upper camp on Tacarcuna, and others were secured from the natives. At the upper camp this species came nightly to feed on what seemed to be a variety of wild fig, a fruit about the size of a man's thumb, with a pink center. Shortly after sundown, a small band of probably eight to a dozen individuals would be heard coming into the fruit tree. They travelled entirely through the trees and did not descend to the ground. Quantities of dead twigs and debris were shaken down by their weight, and their progress could be thus noted when the moving branches could not be seen.

The eyes of the Kinkajou (" Cusumbi " or " Manteja," native names) shine strongly red under the jack light. One was eaten and its flesh proved to be quite palatable. A nasal, grunting, sound was the only call heard.

Specimens collected, 7.— Tacarcuna (2650 feet to 5200 feet altitude), 4; Tapalisa, 3.

42. **Tayra barbara biologiæ** (*Thomas*).

No differences of subspecific value were noted to separate the Darien *Tayra* from *biologiæ* which was described from Veragua, Panama. However, the range of individual variation in the series collected is very great. Upon the one occasion when this animal was encountered by our party, I found it to be most interesting, it having marked resemblance in behavior to our northern weasels and martens. It was exceedingly curious and unafraid.

Specimens collected, 9.— Tacarcuna, 3; Tapalisa, 6.

43. **Lutra repanda** *Goldman.*

Otter were reported to be quite common in the rivers of Darien, where surely the abundant fish life could support them, but only one was noted by our party. I shot one near the junction of the Rio Tapalisa and the Rio Tacarcuna but the wounded animal was lost in the rapid stream. Indian hunters brought in two.

Specimens collected, 2, from Tapalisa.

44. **Myotis chiriquensis** *Allen.*

This small bat was found throughout the region visited.

Specimens collected, 11.— Chepigana, 1; Cituro, 1; El Real, 3; Gatun, 1; Tacarcuna, 2; Tapalisa, 3.

45. **Saccopteryx bileneata** *True.*

One of these bats was taken in Cituro by Richardson.

Specimens collected, 1, from Cituro.

46. **Chilonycteris rubiginosa rubiginosa** *Wagner.*

This species was found in the Chilibrillo caves in smaller numbers than either *Hemiderma* or the large *Phyllostomus.* It seemed to segregate itself and was not found mingled with the other species of the caves.

Specimens collected, 10, all from the Rio Chilibrillo.

47. **Phyllostomus hastatus panamensis** *Allen.*

As the type locality of *panamensis* is Boqueron, Panama, the bats collected in southern and eastern Panama, present no differences from this subspecies.

Specimens collected, 25.— Boca de Cupe, 4; Capeti, 4; El Real, 8; Rio Chilibrillo, 9.

48. **Artibeus watsoni** *Thomas.*

A small series of small *Artibeus* from the lowlands of eastern Panama is indistinguishable from *watsoni* taken at Boqueron by Batty. One specimen, No. 37599, is however much lighter colored with the hair everywhere very light at the base.

Specimens collected, 6, from Chepigana.

49. **Uroderma bilobatum** *Peters.*

These specimens present no noteworthy differences distinguishing them from *bilobatum.*

Specimens collected, 11.— Capeti, 7; Chepigana, 1; El Real, 3.

50. **Hemiderma perspicillatum aztecum** (*Saussure*).

This common species was found in great numbers in limestone caves up the Rio Chagres (Rio Chilibrillo) where it was the most abundant bat of the caves.

Specimens collected, 36.— El Real, 1; Rio Chilibrillo, 30; Tacarcuna, 4; Tapalisa, 1.

51. **Leontocebus geoffroyi** (*Pucheran*).

This small monkey was fairly common throughout the whole region where collecting was done, and specimens from the high mountains of the cordillera are specifically the same as those of the Zone. In this series the yellowish underparts, which Elliott [1] made a character of his *salaquiensis*, a species which he withdrew [2] later upon the basis of additional material, occur frequently and show that this character is a variable one with no diagnostic value.

Specimens collected, 28.— Boca de Cupe, 1; Chepigana, 6; Cituro, 4; Maxon Ranch (Rio Trinidad), 1; Tacarcuna, 12; Tapalisa, 4.

52. **Alouatta palliata inconsonans** *Goldman.*

This monkey was noted the oftenest because of its far reaching call-note. It seemed to be everywhere common from the Zone up to the crests of the cordillera.

Specimens collected, 5.— Cituro, 1; Maxon Ranch (Rio Trinidad), 1; Mt. Tacarcuna (5200 feet), 1; Tapalisa, 1.

53. **Aotus zonalis** *Goldman.*

Although my specimens were taken in southeastern Panama, no material differences between them and the type from Gatun in the Canal Zone are evident. The type is less richly suffused, but this difference is probably not outside the limits of individual variation.

Specimens collected, 8.— Boca de Cupe, 1; Tapalisa, 7.

54. **Cebus capucinus** (*Linnæus*).

The white-faced monkey of the Darien region is considered by Goldman to be typical. This species was taken both in the lowlands and the mountains but skins from the two extremes seem indistinguishable.

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[1] Elliot, Bull. Am. Mus. Nat. Hist., 1912, p. 137.
[2] Elliot. Bull. Am. Mus. Nat. Hist., 1914, p. 644.

Specimens collected, 9.— Chepigana, 1; El Real, 2; Tacarcuna (3000 feet to 5000 feet altitude), 6.

55. **Ateles dariensis** *Goldman.*

Spider monkeys were noted but once in the high mountains (5000 feet), and specimens were secured only at Tapalisa.

Specimens collected, 2, from Tapalisa.

Explanation of Map of Darien Region.

Route taken by the expedition......

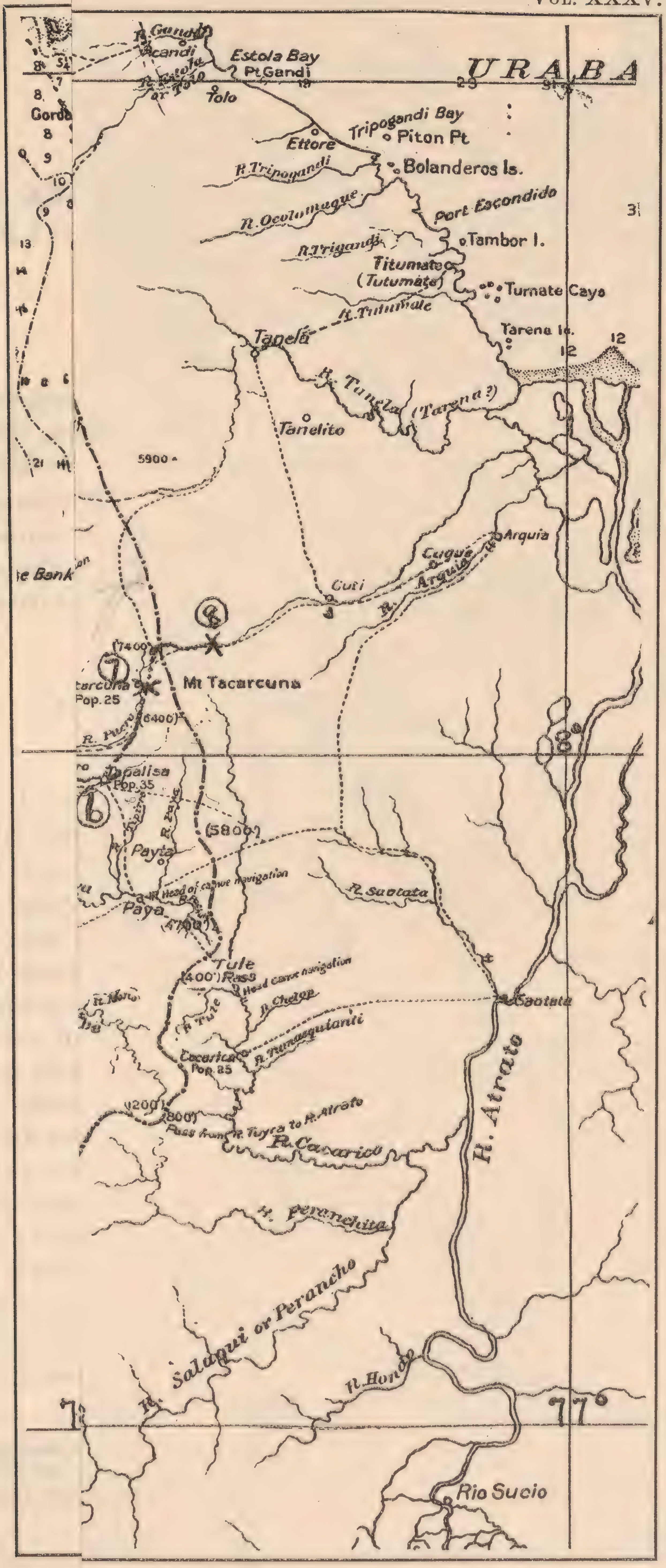
Localities worked, with dates of arrival and departure.

(1) Chepigana.— Nov. 28–Dec. 15, 1914.
(2) El Real.— Dec. 17, 1914–Jan. 23, 1915.
(3) Boca de Cupe.— April 26–May 4, 1915.
(4) Cituro.— May 6–May 20, 1915.
(5) Capeti.— May 23–May 29, 1915.
(6) Tapalisa.— Feb. 16–March 18, 1915.
(7) Tacarcuna.— Feb. 20–March 27, 1915.
(8) Mt. Tacarcuna.— March 28–April 18, 1915.

Goldman's localities of Mt. Pirri and Cana indicated on map by crosses ×.

Principal localities in the Canal Zone (not shown on map) with dates of collecting.

Gatun.— Feb. 14–18; Feb. 25–March 4, 1914.
Old Panama.— Feb. 20–23, 1914.
Maxon Ranch, Rio Trinidad.— March 7–17, 1914.
Rio Chilibrillo.— March 1 and March 24, 1914.


U R A B A
R. Gandi
Gandi
R. Estola
or Tolo
Estola Bay
Pt Gandi
Tolo
Gord
Tripogandi Bay
Piton Pt
Ettore
Bolanderos Is.
R. Tripogandi
R. Ocolomaque
Port Escondido
Tambor I.
R. Trigandi
Titumate
(Tutumate)
Turnate Caya
R. Titumate
Tanelá
Tarena Is.
R. Tanela (Tarena?)
Tanelito
5900
Arquia
Cugue
R. Arquia
Cuti
e Bank
(7400)
Tacarcuna
Pop. 25
Mt Tacarcuna
(6400)
R. Pucro
Tapalisa
Pop. 35
(5800)
Payta
Head of canoe navigation
Paya
(4700)
R. Sautata
Tule
(400) Pass
Head canoe navigation
R. Nono
R. Tule
R. Chelop
R. Tumasquianti
Cacarica
Pop. 25
Sautata
(200)
(800)
Pass from R. Tuyra to R. Atrato
R. Cacarica
R. Atrato
R. Perancheita
Salaqui or Perancho
R. Honde
R. Sal
7°
77°
Rio Sucio
8°
12

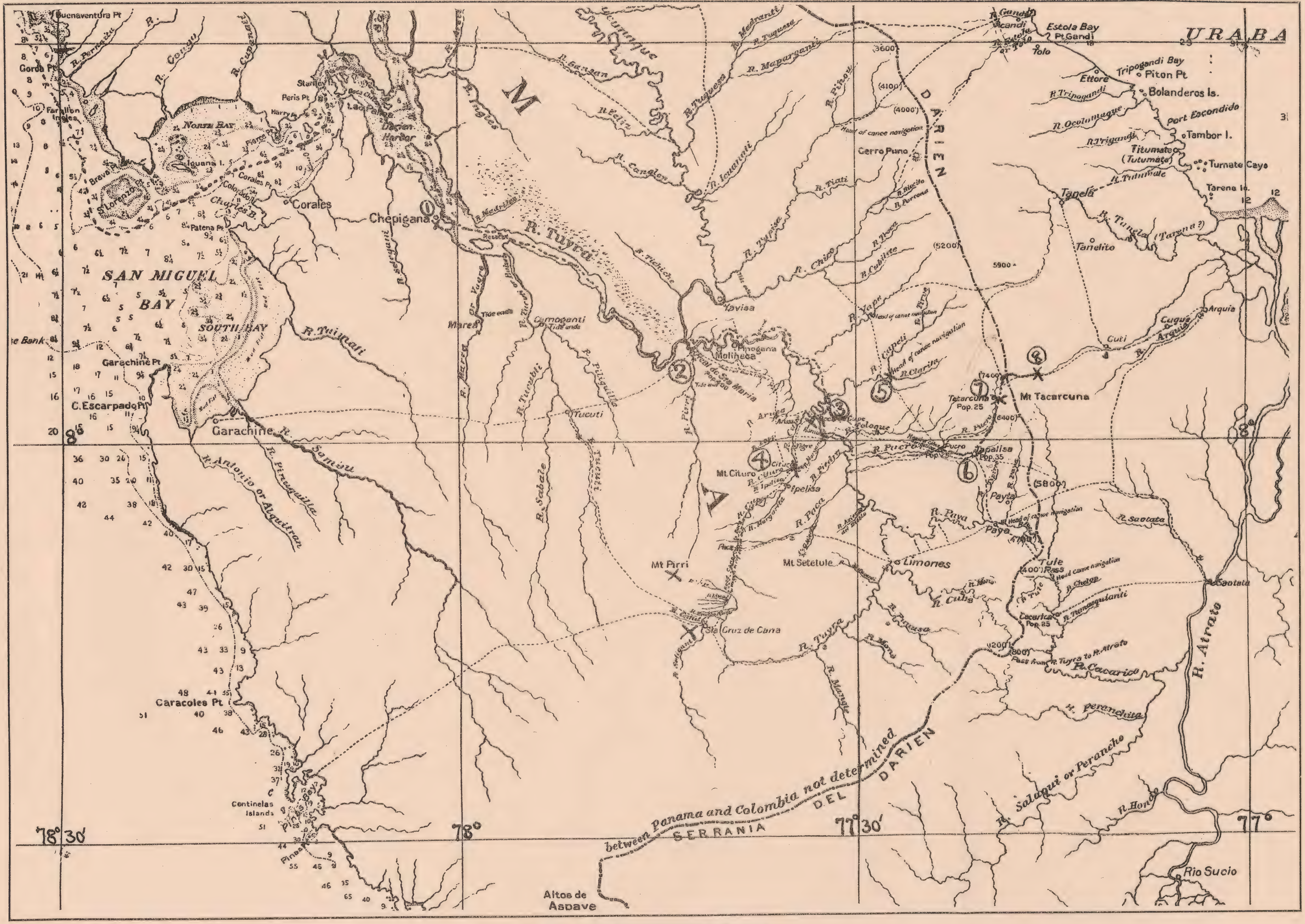


Fig. 6.—Map of Darien Region.

59.57,72M: 13.41

Article XXI.— PARASITIC MUSCID LARVÆ COLLECTED FROM THE AFRICAN ELEPHANT AND THE WHITE RHINOCEROS BY THE CONGO EXPEDITION.[1]

By J. Bequaert.

I am greatly obliged to the American Museum for the opportunity which has been given me to study certain parasitic larvæ collected by Messrs. Lang and Chapin in the course of their expedition to the Belgian Congo. The parasites here reported upon are all of known species but our knowledge of these insects is, as yet, so fragmentary that I think it worth while to review the material which is before me, especially as it may encourage hunters and sportsmen in Africa to collect such parasites.

A. Larvæ parasitic upon the African Elephant (*Loxodon africanus* Blum.).

1. Larvæ in the sole of the foot: *Neocuterebra squamosa* Grünberg[2]; one vial containing larvæ in the third stage with the label "Fly larvæ from sole of foot of elephant ♂, Avakubi, May 10, 1914" (Belgian Congo: Ituri). These larvæ do not differ in any particular from the original description or from those which I have seen from the Lower Uele.[3] They seem to be rather rare and, as yet, have been found only in the forest region.

Through the courtesy of Mr. Chas. Schaeffer, of the Museum of the Brooklyn Institute, I was able to compare the larvæ from the foot of the African Elephant with the cuticolous parasites forming the Muscoidean genus *Cuterebra* B. Clark (= *Cutiterebra* Scudder). The latter is peculiar to North and South America, where it appears to present numerous forms; but, as a whole, our biological knowledge of these insects is in a very unsatisfactory state. There have been described, so far, over thirty species, but nearly all of them from imagoes only; furthermore, the specific identity of some of the few recorded larvæ has not been definitely cleared up.

From an examination of a good series of *Cuterebra* and *Dermatobia* Br. it seems to me that both genera must be included, on account of the morphological structure of the imagoes, in Girschner's Muscoidean group "Tachinidæ."[1] The hypopleural bristles are present and numerous, but distributed irregularly over the hypopleuræ and in the same hairy (apparently degenerate) condition as in some other parasitic Muscoidean groups (Œstrinæ *s. str.* Hypoderminæ); the sternopleural bristles are completely wanting; the curve of the fourth longitudinal wing-vein is well marked, the raised branch forming a distinct apical cross-vein. The thoracic calypter (*squamula thoracalis*) is strongly developed and projects far behind the margin of the alar calypter (*squamula alaris*); the alulets are separated by a narrow acute notch but are contiguous at the base. As to the further affinities of these genera in the "Tachinidæ" group, they are nearly related to the Œstrinæ *s. str.* and Hypoderminæ, presenting like both of these, a very strongly developed ventral membrane, which surrounds entirely the relatively small, somewhat depressed abdominal sternites. At the present time, however, it would seem best to leave them as a special tribe or subfamily "Cuterebrinæ," although, apart from the deep oral slit containing the rudimentary geniculate proboscis, I was unable to find any peculiar character. Probably we must include in the same group the genera *Rogenhofera* Br. and *Bogeria* Austen, and perhaps also *Pseudogametes* Bischof; but these three genera are, thus far, unknown to me.

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[1] Scientific Results of the Congo Expedition. Entomology, No. 1.

[2] Sitz. Ber. Ges. Naturf. Freunde, Berlin, 1906, p. 46, fig. 6–9.

[3] See J. Rodhain and J. Bequaert, Bull. Soc. Path. exot. Paris, VIII, 1915, p. 765.

Returning now to the larvæ of *Cuterebra,* their morphological characters apparently do not give any indication as to the systematic position of these parasites. So far as I am aware, these larvæ are only described in the third stage, and in this stage their general structure is, at first glance, very similar to that of most cuticolous larvæ, even of distant relationships, and this results, I suppose, merely from convergent adaptations. I must refrain, however, from any detailed discussion of the *Cuterebra* larvæ, but I think that a comparison of these parasites with the dipterous larvæ from the foot of the African Elephant will not be without interest.

As to the external morphological characters, *Neocuterebra* and *Cuterebra* look very much alike indeed. Their general aspect and shape are the same. They present the same peculiar structure of the posterior end of the abdomen. In *Neocuterebra* the twelfth segment is very small, smaller indeed than in the *Cuterebra* larvæ I have examined, and completely retracted in the eleventh. The mouth-hooks are also very slender and probably functionless. Furthermore, the spinulation is formed by the same flattened, scale-like spines, covering nearly the whole of the body; in both genera intermediate median fields between the segments are completely lacking. With regard to the longitudinal pads on the sides, I do not think there is so much difference between *Cuterebra* and *Neocuterebra* as was pointed out by Grünberg (*loc. cit.*). The figures of "*Cuterebra emasculator* Fitch" as published in Insect Life, I, 1889, p. 214, show such lateral pads very strongly marked, but from what I could see on the Brooklyn Museum material this is rather a post-mortem appearance. The living *Cuterebra* larvæ must be, I believe, nearly double-convex, only slightly or not at all dorso-ventrally depressed, although somewhat broader than thick.

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[1] See Berliner Entom. Zeitschr., XXXVIII, 1893, pp. 297–312; Illustr. Wochenschr. f. Entom., I, 1896.

A closer examination, however, of the internal structure of the larvæ reveals that *Neocuterebra* and *Cuterebra* have not the slightest affinity: *Cuterebra* is amphipneustic, the anterior spiracles being very strongly developed and becoming horn-like structures projecting anteriorly in the puparium (as I could see in a fine example kindly given to me by Mr. Wm. T. Davis). These horn-like projecting spiracles were sometimes mistaken for larval antennæ, with which they have no relation whatever. The two cephalic segments (proto- and postcephalon) are distinctly separated (the body thus presents twelve distinct segments) and each of the antennal papillæ bears two small ocellar chitinous spots. The two posterior stigmatic plates are large, semilunar or reniform, openly exposed at the bottom of the retracted twelfth segment and easily detected in most larvæ; they are of the so-called "porous" type (as those of *Œstrus* and *Hypoderma*), but their inner structure has never been worked out.

In *Neocuterebra* on the other hand, the larvæ are metapneustic, the anterior spiracles being not at all visible externally. The two cephalic segments are completely fused in a single pseudocephalon (therefore the larvæ have apparently only eleven segments); each antennal papilla bears a single distinct ocellar spot. The two posterior stigmatic plates are small, oval, entirely hidden in a deep cavity of the anal segment closed by two somewhat chitinized falcate lips (these may be at first glance mistaken for the posterior spiracles); each plate bears three elliptical, elongate, transverse peritremes, which are straight or slightly curved.

From the preceding remarks it appears that *Neocuterebra* cannot be reasonably placed in the American group of the Cuterebrinæ. Its relations to the true cuticulous group Hypoderminæ are still less apparent.

Judging from the characters afforded by the larvæ, the nearest allies of *Neocuterebra* are perhaps some Calliphorinæ parasites belonging to the African genus *Cordylobia* (especially the more strongly developed form *C. rodhaini* Ged.); but as the imago is still unknown, it is not possible to fix definitely the systematic position of *Neocuterebra squamosa* among Diptera.

2. Larvæ in the stomach.— In a paper written in collaboration with Rodhain (*loc. cit.* 1915, p. 768–778) we have brought together the facts concerning these parasites and have shown that there are two distinct species of larvæ in the stomach of the African elephant.

The material collected by Messrs. Lang and Chapin, which is very abundant, contains but one of these species: *Cobboldia loxodontis* Brauer (Denkschr. k. Ak. Wiss. Wien, math. naturw. Cl., LXIV, 1897, p. 267). Certain of these larvæ are fully developed, attaining a length of 26 mm. and a breadth of 6.5 mm.; all are in the third stage; the smallest is not more than 10 mm. in length but, nevertheless, has three peritremes in each stigmatic plate. The second stage larva of *Cobboldia* does not seem to have been described.

The larvæ collected by Messrs. Lang and Chapin were found in the savannah region of the Uele (northeastern Congo), a smaller number from Bagboro (near Yakuluku, October 1911); and by far a larger number from Vankerckhovenville (April 9, 1912).

I think that it is not without interest to state here that, thanks to the kindness of Mr. R. Van Saceghem, I have recently been able to study gastric larvæ from elephants collected at Bokala (Middle Congo, near the mouth of the Kasai). In this way I have been able to determine that in this region, just as in the forest region of the Lower Uele, the two species of *Cobboldia* (*C. loxodontis* Br. and *C. chrysidiformis* R. & B.) live together in the stomach of the same individual elephant. Perhaps it is normal for the two species to live together in the forest region of Africa whereas in the savannah region *C. loxodontis* Br. may occur alone. This suggestion could be easily and with interest verified by collecting larvæ in the different regions. These two species of *Cobboldia* may be easily separated in their larval state in the following way: *C. chrysidiformis* R. & B. has a conical papilliform protuberance on each side of segments eight to eleven, while these protuberances are absent from *C. loxodontis* Brauer.

B. Gastric larvæ of the White Rhinoceros
(*Rhinoceros* [*Ceratotherium*] *simus cottoni* Lyd.).

The existence of larvæ in the stomach of rhinoceroses has been known for a long time but it is only recently that we have had any definite information concerning the life history of these parasites. The first reference to the presence of Œstrid larvæ in the stomachs of African rhinoceroses dates from 1839: Hope, in a paper on the parasitic larvæ of man[1] figures incidentally (but without description) one of these parasites as "*Œstrus rhinocerontis* Owen," under which name it was classified in a museum (*op. cit.*, p. 259, Tab. XXII, fig. 1 and 1*a*). In 1863, Brauer (Monogr. d. Œstrid, p. 92) briefly described, after the figure of Hope, the same larva under the name of

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[1] Trans. entom. Soc. London, II, pt. 3, pp. 256–271, Tab. XXII.

"*Gastrophilus rhinocerontis.*" As there exist many similar gastric Œstridæ in the African rhinoceroses, it is impossible to refer the parasite of Hope to one of those described later.

The presence of gastric larvæ in the rhinoceroses of South Africa was referred to by the explorer Delegorgue, in this way: "Le rhinocéros simus en avait aussi quelque peu, non sous la peau, mais dans son estomac. Le rhinocéros africanus bicornis pourrait bien réclamer le titre de père nourricier des œstres. On ne saurait s'imaginer la quantité contenue dans son estomac, c'était à les mesurer au boisseau, à les prendre à la pelle. Cette différence en nombre est constante chez les deux espèces et j'incline fortement à penser que le rhinocéros africanus bicornis ne doit sa méchanceté, la fureur qui le distingue, qu'à la présence de ces milliers de parasites, absolument comme l'homme qu' habite le ténia." [1]

Although these parasites are abundant in their hosts, definite information concerning them is of relatively recent date. In 1885, Brauer was able, for the first time, to examine the gastric larvæ from a specimen of *Rhinoceros sumatrensis* which died in the Zoölogical Garden at Hamburg. He recognized that they were distinct from *Gasterophilus* and placed them in a new genus *Gyrostigma,* under the name of *G. sumatrensis.*[2] In 1892 [3] he referred to the same genus the African larvæ of *Œstrus rhinocerontis* Owen, figured by Hope.

A very remarkable Œstrid imago was described in 1895 by Corti, from the Galla country, under the name of *Spathicera pavesii.*[4] The author made the suggestion that perhaps it came from a gastric larva, probably *Cobboldia* or *Gyrostigma.* Brauer, in completing the description of this fly, showed also the great probability of the identity of *Spathicera* with *Gyrostigma.*[5] He again refers to this hypothesis in the description of *Gyrostigma rhinocerontis bicornis* on larvæ from an East-African rhinoceros.[6]

It was not until ten years later that this identity was definitely established by Y. Sjöstedt [7] who succeeded in rearing an imago from a larva collected in *Rhinoceros* (*Diceros*) *bicornis* from Kilimanjaro. The species which he named *Spathicera meruensis,* seemed to him different from the imago *Spathicera pavesii* Corti and also from the larva *Gyrostigma rhinocerontis bicornis* Brauer.[8] In commenting upon this discovery of Sjöstedt,

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[1] Voyage dans l'Afrique australe, II, 1847, p. 351.

[2] Verh. k. k. zool. bot. Ges. Wien, XXXIV, pp. 269–270, Tab. X.

[3] Sitz. Ber. K. Ak. Wiss. Wien, math. naturw. Cl., CI, Abth. 1, p. 8.

[4] Ann. Mus. civ. Genova, Ser. 2, XV, pp. 144–147.

[5] Sitz. Ber. K. Ak. Wiss. Wien, math. naturw. Cl. CIV, Abth. 1, 1895, pp. 582–588, Tab.

[6] Denkschr. k. Ak. Wiss. Wien. math. naturw. Cl., LXIV, 1897, p. 261, Tab. fig. 19.

[7] Wiss. Ergebn. Schwed. Zool. Exp. Kilimandjaro, 1905–1906, Bd. II, Abth. 10, 2, 1908, pp. 11–19, Tab.

[8] See also E. Bau, Centralbl. f. Bacter. Parasitenk. Abth. 1. Orig. Bd. XLVIII, 1908, pp. 164–167.

Poulton[1] refers to a curious observation by S. A. Neave: in 1908 that entomologist observed, in the valley of the Luangwa River (N. E. Rhodesia), three very large flies, on the carcass of a freshly killed rhinoceros. These Diptera, which were without doubt *Spathicera,* were unwilling to leave the carcass and allowed themselves to be picked off by hand. Neave noticed also the astonishing resemblance of these flies to certain large Hymenoptera (*Salius* sp.) which are bluish black with orange legs.

The studies of G. Enderlein on the gastric larvæ of rhinoceroses should also be noted. In 1899, he made a very complete histological examination of the respiratory organs of *Gyrostigma* and incidentally pointed out the existence of *G. sumatrensis* Br. in *Rhinoceros lasiotis.*[2] He later described, under the name of *Gyrostigma conjungens,* a remarkable larva from *Rhinoceros bicornis* from Kilimanjaro, and at the same time referred to *Gyrostigma rhinocerontis bicornis* Br. other larvæ from East Africa (according to Sjöstedt, 1908, *op. cit.*, the latter larvæ really belong to *Spathicera meruensis* Sjöst.[3]). Finally, more recently, Enderlein, noting that the characters of his *Gyrostigma conjungens* were in certain respects intermediate between *Gyrostigma* Br. (= *Spathicera* Corti) and *Gasterophilus* Leach, made his species the type of a new genus *Stomachomyia.*[4]

The rearing of the imago of *Gyrostigma meruensis* by Sjöstedt (1908) has definitely proven the identity of the genera *Gyrostigma* Brauer (1885) founded on the larvæ of a species from Sumatra, and *Spathicera* Corti (1895) described from an imago captured in Abyssinia. According to the rules of zoölogical nomenclature now in use, there is no doubt that the first of these names should have priority. As yet *G. meruensis* Sjöst. was the only species of the genus known both from larva and imago. Moreover, there were described three different larvæ for which the corresponding imagoes had not been obtained:

G. sumatrensis Brauer 1885, from Sumatra;
G. rhinocerontis bicornis Brauer 1897, from Africa;
G. conjungens Enderlein 1901, from Africa.

Finally *G. pavesii* Corti 1895 had been described from an Abyssinian imago and no larva corresponding to it was known.

In 1914 my good friend Dr. J. Rodhain, who by his patient researches has contributed very largely to the progress of African parasitology, succeeded in rearing a number of imagoes from gastric larvæ collected from *Rhinoceros simus cottoni* Lyd. in the Uele district (northeastern Congo).

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[1] Proc. Entom. Soc. London, 1908, p. XXIX–XXX.
[2] Sitz. Ber. K. Ak. Wiss. Wien, math. naturw. Cl. CVIII, Abth. 1, pp. 235–303, Tab. I–III.
[3] Arch. f. Naturg. Jahrg. LXVII, Beiheft, 1901, pp. 23–39. Tab. I.
[4] Stettin. entom. Zeitg., LXXII, 1911, pp. 141–144.

He was also able to clear up the mystery of oviposition and of the first larval stage of that insect.[1] Dr. Rodhain kindly turned over this precious material to me for study. It was, therefore, possible for me upon my return to Europe, to establish the identity of the reared imagoes with *Gyrostigma* (*Spathicera*) *pavesii* Corti; on the other hand, the larvæ from which these flies came could in no way be distinguished from those to which Brauer gave the name *Gyrostigma rhinocerontis bicornis*. This species, therefore, should bear the name of *Gyrostigma pavesii* (Corti).[2]

The Congo Expedition collected in the same region as did Dr. Rodhain numerous larvæ from the white rhinoceros. The label which accompanied these specimens bore the note "Faradje, Feb. 3 and 5, 1912, from Rhinoceros; most of the stomach practically studded." They did not differ from those which I had previously examined from the Uele district and must also be referred to *Gyrostigma pavesii* Corti (syn: *G. rhinocerontis bicornis* Brauer).

The larvæ collected by Dr. Rodhain (May, 1914) are in the third stage. This is true also of a large number (60 to 70) of the parasites collected by Messrs. Lang and Chapin; some of them are of very large size, measuring 35 mm. in greatest length and 15 mm. in greatest breadth; the others are much smaller, being not more than 16 mm. in length and 6 mm. in breadth; but the presence of three peritremes on each stigmatic plate shows that they have already moulted twice. These larvæ of the third stage correspond very well to the description given by Brauer and Sjöstedt. Every stigmatic plate bears three peritremes, each of which is very strongly sinuate, like a number of *S*'s joined end to end; the result is that the plate is completely covered by their numerous windings. The spines of the girdles are numerous, those of the anterior row on each segment are so close together that they nearly touch each other at their bases. The color of the tegument is uniform, without dark spots; it is dirty white in the small larvæ and pale horny brown in the larger ones.

The material provided by the Congo Expedition contains also a number of *larvæ of the 2nd stage*. This stage does not appear to have been recorded as yet, so that I think it worth while to describe them more in detail. (Fig. 1.)

They may be immediately recognized by the peculiar structure of their posterior stigmatic plates, each of which shows only two feebly sinuated peritremes. Some of them attain a length of 20 mm. and a greatest breadth

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[1] Cf. J. Rodhain, Note sur la ponte des Œstrides des genres *Gyrostigma* et *Cobboldia*. Bull. Soc. Path. exot. Paris VIII, 1915, pp. 275–279.

[2] I hope to publish later, in collaboration with Dr. Rodhain, a complete study of the gastric parasites of rhinoceroses.

of 6 mm.; others are much smaller, not surpassing 10.5 mm. in length and 3 mm. in breadth. Their general aspect is somewhat different from that of the full-grown larvæ; they are much longer and vermicular, three to three and a half times as long as broad. The greatest breadth is not at the middle of the body but towards the posterior extremity, usually at the eleventh segment; in front of this segment the body gradually tapers toward the cephalic extremity, which is slightly more pointed than in the third stage. The larvæ are very slightly flattened dorso-ventrally, often nearly cylindrical, especially in the posterior half.

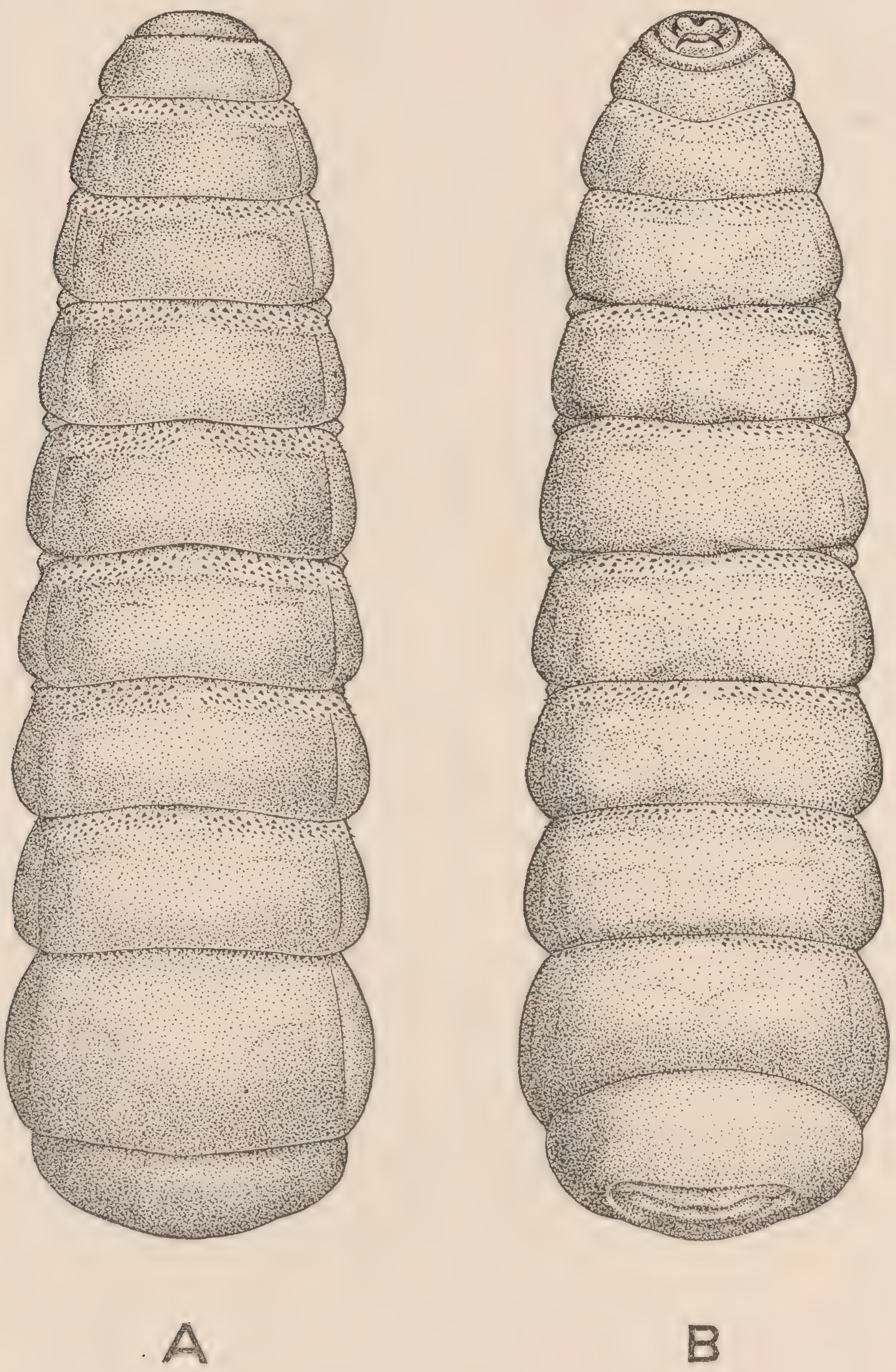

Fig. 1. *Gyrostigma pavesii* (Corti). Larva of the second stage. × 5. A. Dorsal view. B. Ventral view.

The twelve segments are very distinctly separated and they increase in length from the first to the eleventh; the latter segment is very well developed, especially on the dorsum; the twelfth is cut much shorter than the eleventh and slightly larger on the ventral than on the dorsal face.

On the ventral side there are sometimes traces of median, intermediate fields between segments five and eight; and there are even broad transverse elevations on each side of the median line, which perhaps may be used as ambulatory pseudopodes. On the sides the longitudinal superposed pads and the transverse intermediate pads have the same arrangement as in the third stage.

The concavity on the posterior face of the anal segment (twelfth) is usually deeper and inclosed by better developed lips than is the case in the full-grown larva, so that the small stigmatic plates are not usually seen. However, each of these anal lips bears four superficial papillæ, as in the third stage.

The cephalic (first) segment bears two antennal pads constricted at the base, very broad and flattened at the apex, relatively much nearer the median line than in the third stage. Each of these shows two very pale (sometimes almost invisible) ocellary spots; I was not able to make out a chitinous basal ring. There are two pairs of buccal hooks which are practically of the same shape and arrangement as in the full-grown larva. The external pair are claw-shaped, dark brown, and their bases inclose the internal pair which are much shorter, often retracted, conical stiletto-shaped, pale, slightly brownish.

The larvæ are amphipneustic. The anterior stigmata have the same structure as in the third stage. Their external aperture is situated on the side in the fold between the second and the third segments, but it is very small and difficult to see. The posterior stigmatic plates are small (about 0.8 mm. long and 0.52 mm. in greatest breadth) and occupy only a small area of the posterior face of the twelfth segment. They are oriented as in the full-grown larvæ, but their shape is somewhat different: they are oval, much broader toward the ventral third; their inner margin is only slightly emarginate toward the dorsal third, and it is at this level that one sees between the two plates the scar of the stigmatic orifice of the first stage.

In each plate are two sinuate peritremes each forming a single irregular S, so that two well marked curved angles are present; their general aspect then is nearly that noticed in the third stage of *Gyrostigma sumatrensis* Br. (according to the figures of Brauer and Enderlein, for I have never seen specimens of this species). Each peritreme attains a length of about 1.12 mm. and shows on the outside a series of transverse chitinous ridges numbering sixty to sixty-five and placed about 0.018 mm. from each other; every one of these ridges corresponds to an internal curved supporting plate.[1] (Fig. 2.)

The spinulation has a somewhat different appearance from that of the third stage larva: the spines are scarcely visible, nearly colorless, only the points slightly brownish; they are very small, quite numerous and close together. The first segment (protocephalon) bears a complete girdle of minute spines which cover the inferior labial pad and extend even back of the antennæ; the second (postcephalon) is unarmed. Segments three to nine are furnished on the anterior border with a continuous girdle of spines, very close together in three or four rows, covering about the anterior quarter of the segments, the spines of the anterior row being slightly stronger than the others. On the tenth segment the spinous girdle is continuous on the ventral face and slightly interrupted along the median line on the dorsal face; the eleventh segment seems to be unarmed on the dorsal face and on the ventral face bears one or two feeble lateral rows of spines; the twelfth segment is unarmed. The intermediate lateral pads between segments five to nine also have three or four minute spines; the one between the ninth and tenth segment is unarmed.

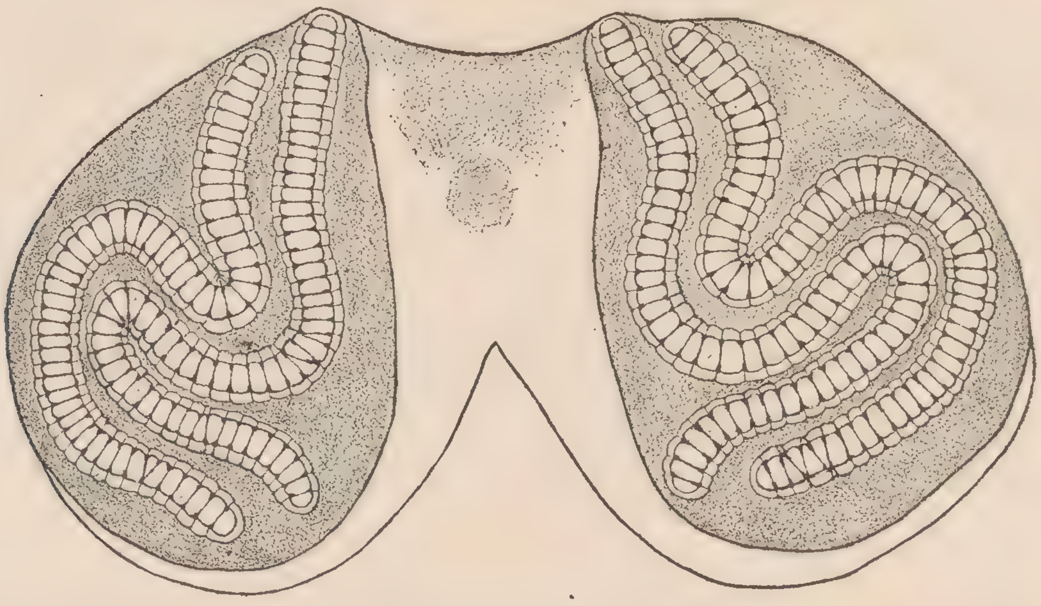

Fig. 2. *Gyrostigma pavesii* (Corti). Posterior stigmatic plates of second stage larva. × 50.

Behind the spiny girdles there are often on the dorsal and ventral faces of each segment a transverse series of minute elongated brownish spots: in some larvæ they are quite visible to the naked eye and they then somewhat resemble spines. These spots seem to be sub-epidermal and, moreover, they are not always very distinct; their significance is unknown, but perhaps they are nerve-endings.

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[1] For the detailed structure of the stigmatic plates of *Gyrostigma* compare Enderlein, Sitz. Ber. k. Ak. Wiss. Wien, math. naturw. Cl., CVIII, Abt. 1, 1899, pp. 235–303, Tab. I–III.

It should be noted that the rhinoceros from which Messrs. Lang and Chapin collected both the second and third stages was shot early in February, a date which corresponds to the height of the dry season in the savannah of the Uele district. Mr. Chapin informs me that the dry season in this region is very pronounced from December to April. At the beginning of the rainy season (May) Dr. Rodhain found only larvæ of the third stage in the rhinoceros. Therefore, there must be a period of the year (probably corresponding to the last half of the dry season) during which no adult flies emerge. But here again it is desirable to have further observations made on the spot before we can establish the different periods in the seasonal development of this parasite.

Thanks to the kindness of Dr. Rodhain, I am able to figure for the first time the puparium of *Gyrostigma pavesii* (Corti) from a photograph taken in the Congo by Mr. Lebrun (Fig. 3).

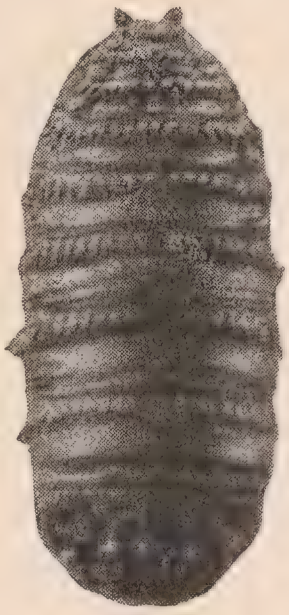

Fig. 3. *Gyrostigma pavesii* (Corti). Puparium. Natural size. (Photographed by M. Lebrun.)

In the material collected by the Congo Expedition there are a certain number of larvæ attached to other parasites of the alimentary tract; *e. g.* Scoleces of Tæniids. But according to the verbal explanation given by Mr. Lang, this attachment certainly happened after the parasites left the stomach, since there they are always attached to the walls. This seems to be indicated furthermore by the fact that larvæ of *Gyrostigma* sometimes are found attached to true intestinal worms. Mr. Lang also observed that when placed on the hand, the larvæ of *Gyrostigma* are able to attack the human skin by their powerful hooks and thus produce a sharp pain.

59.82(87)

Article XXII.— TWO NEW BIRDS FROM VENEZUELA.

BY GEORGE K. CHERRIE.

Hemithraupis flavicollis aurigularis subsp. nov.

Char. subsp.— Similar to *H. f. flavicollis*, but yellow of throat with wash of cadmium (not clear golden-yellow), fore neck and sides of breast with numerous blackish transverse bands produced by subterminal bands on the individual feathers. The black of the head and mantle intermediate in color between the "deep velvety black" of *f. centralis* and the dull brownish black of *f. flavicollis*. Smaller than either *f. flavicollis* or *f. centralis*, wing average 65 mm., tail 49 mm.

Type.— ♂ ad., Suapure, Venezuela, Sept. 9, 1901 (No. 75922 Am. Mus. Nat. Hist.; S. M. Klages).

Remarks: The female differs from the female of *f. flavicollis* by being deeper darker olive above. The edges of the greater wing-coverts and the primaries are dull yellowish olive (in *f. flavicollis* the color is bright olive yellowish).

Mr. Hellmayr (Novit. Zool., XIV, 1907, p. 351) has called attention to the heavy barring of the breast of some of the Caura River specimens in the Tring Museum, and his table of measurements exhibits the smaller size.

I consider the marked difference in color between the females of this new form and that of *f. flavicollis* as of as great importance in distinguishing the race as is the difference in size and color between the males.

Miller and Iglseder collected at Boca de Sina, Rio Cunucunuma, Upper Orinoco, March 19, 1913, an adult male that pertains to this race. This specimen is also in the American Museum collection.

Argicus macrodactylus caurensis subsp. nov.

Char. subsp.— Similar to *A. macrodactylus macrodactylus* but with the underparts darker, the irregular narrow blackish transverse lines being closer together and the white area back of the black breast-band much reduced, almost obsolete. The general color of the breast and abdomen in *m. macrodactylus* is cinnamon-buff, in *m. caurensis* dusky olive-buff.

Type.— ♀ ad., La Union, Caura River, Venezuela, Aug. 10, 1901 (Am. Mus. Nat. Hist., No. 76135); S. M. Klages. Wing, 67; tail, 58; bill, 22 mm.

59.82(8)

Article XXIII.— NEW BIRDS FROM THE COLLECTION OF THE COLLINS-DAY EXPEDITION TO SOUTH AMERICA.

By George K. Cherrie.

Taraba major virgultorum subsp. nov.

Char. subsp.— Similar to *T. major major* but with less white on the wings. The outer webs of the primaries not edged with white, and only the two innermost of the greater wing-coverts tipped with white. Many of the median and lesser wing-coverts without white tips and less tips conspicuous in all than in *major major*.

Type.— ♂ ad., Todos Santos, Rio Chaparé, Bolivia, March 13, 1915; Geo. K. Cherrie, No. 18522. Wing, 89; tail, 73; bill, 25 mm.

Remarks.— The female is readily distinguished from female examples of *major major* by the generally darker color of the back and wings. The mantle is nearly a 'saccardo's-brown' and the ends of the wing-quills decidedly fuscous. In *major major* the back is cinnamon and the tips of the wing-quills not noticeably fuscous.

Xiphorhynchus guttata rimarum subsp. nov.

Char. subsp.— Similar to *X. guttatoides* but darker above, the back and mantle mummy-brown; and without the rufescent wash on the underparts that is so conspicuous in that race. From *dorbignyana* it is at once distinguished by having the pale shaft-streaks on the lower throat with black lateral borders.

Type.— ♀ ad., Mouth of Rio San Antonio on Rio Espirito Santo, Bolivia, March 6, 1915; Geo. K. Cherrie (No. 18621). Feet slate-gray. Wing, 112; tail, 98 mm.

Description of Type.— Above head blackish merging on the occiput and hindneck into the mummy-brown of the back and mantle. The pale centers to the forehead and crown-feathers are tear-shaped, but on the occiput and hindneck they become elongated oval shaft stripes, and on the back shrink to mere shaft lines. On the forehead and crown the markings are pale buff; on the occiput and back ochraceous-buff. Bend of wing and coverts similar to the mantle. Lower back, rump, upper tail-coverts, tail and wing-quills (on outer webs) auburn. Throat pale cinnamon-buff, unspotted. Middle of upper breast nearly a sepia-brown, blending posteriorly on the breast and belly into a tawny-olive and on the under tail-coverts into snuff-brown. Lower throat and upper breast marked with rather broad cinnamon-buff shaft-stripes that are edged laterally with blackish. Bill whitish horn color.

Capito auratus insperatus subsp. nov.

Char. subsp.— Similar to *C. auratus auratus* but with throat unspotted; and the absence of an orange or cadmium-yellow wash on the middle of the breast and abdomen separates it from both *a. intermedius* and *a. aurantiicinctus.*

Type.— ♂, Todos Santos, Rio Chaparé, Bolivia, March 10, 1915 (Geo. K. Cherrie, No. 18543).

Description of Type.— General color above black with a sulphur-yellow stripe on each side of the mantle formed by the outer sulphur-yellow edges to the feathers. Rump and upper tail-coverts black, the feathers edged with sulphur-yellow, wing-coverts black; the greater series with a sulphur-yellow spot on the outer webs forming a wing-band. Wing-quills black edged with olive-brown on the outer webs; tail bright olive-brown; forehead and crown bright sulphine-yellow (Ridgway's Color Standards) with faint bronzy gloss, the same color continues back across the occiput but only as the narrow tips and edges to the dusky blackish occipital feathers. Chin whitish, throat orange, chest and breast citron-yellow; feathers of sides of breast somewhat sparsely marked with elongate blackish shaft spots. Middle of belly and crissum pale yellowish; under tail-coverts with dusky centres.

Remarks.— The female, like those of *a. intermedius* and *a. aurantiicinctus,* differs from that of *a. auratus* in the absence of black spots on the throat; and from the two more closely allied forms by the absence of an orange or cadmium wash on the belly.

I have a male from Todos Santos and a female from mouth of the San Antonio, Rio Espirito Santo, Bolivia, localities from which one might expect to find birds referable to the typical race, but the unspotted throat of the female indicates a closer relationship to *a. intermedius* or *a. aurantiicinctus.* On the other hand, the total absence of an orange or cadmium-yellow wash on the middle of the breast and abdomen segregates it from both of those races. Also the color of the crown and occiput is entirely distinct from that of any of the three known races of *auratus,* being sulphine-yellow without admixture of ochraceous-orange, and a much less amount of bronze gloss. The middle of the breast is also without orange or cadmium-yellow wash.

It seems to the writer somewhat doubtful if *a. intermedius* (from Nericagua, Upper Orinoco) is really distinct from *a. aurantiicinctus* (from the Caura). There is in this museum a very good series from the upper Orinoco (Boca de Sina, Cunucunuma River) that are hardly to be distinguished from two examples from the Caura (La Union), that are doubtless typical of *a. aurantiicinctus,* having a very pronounced, although perhaps less intense wash of orange-yellow on the middle of the lower breast.

Piaya rutila chaparensis subsp. nov.

Char. subsp.— Similar to *P. rutila panamensis* Todd, but darker above (nearly a liver-brown) and below. The hazel, or rufous-brown color (as in *panamensis*), confined to the chin and throat, *not* extending over the breast.

Type.— ♂ ad., Todos Santos, Rio Chaparé, Bolivia, March 12, 1915. No. 18507, Geo. K. Cherrie. Wing, 107; tail, 162; bill, 20 mm.

Description of Type.— Above bright bay (in some lights nearly a liver-brown), slightly paler, more rufous on the forehead and crown and darker on the lower back, rump and tail; the latter washed with a purplish wine color. Wing-quills bright hazel-brown on the inner webs, the outer webs uniform with the color of the back, except the distal fourth of those forming the wing-tip which are brownish black. On the tips of the secondaries there is a bronzy brownish wash. Below the chin and throat are hazel-brown, blending on the breast into dusky wood-brown and on the flanks, middle of belly and under tail-coverts into dusky clove-brown. Rectrices tipped with white and a subterminal brownish black band (visible from both the upper and underside) that blends gradually into the general color of the feathers.

Remarks.— A second specimen, ♂ ad., Todos Santos, Rio Chaparé, Bolivia, March 15, 1915, No. 18514, Geo. K. Cherrie. Wing, 103; tail, 147; bill, 20 mm. The bronzy tips of the secondaries are a little more prominent than in the type.

This race is close indeed to *panamensis* but the darker upperparts, particularly the head, with the color scarcely lighter even on the forehead and the darker throat seem distinctive.

The material at hand seems to indicate that there is yet another race of this Cuckoo found in the lower and middle Orinoco region, including the Caura, and extending its range across the Llanos of the Rio Meta to the foot of the Andes at Villavicencio, Colombia, for which I propose the name

Piaya rutila orinocensis subsp. nov.

Char. subsp.— Similar to *P. r. gracilis*, but with darker buffy brown breast and belly and darker amber-brown chin and throat (instead of rich ochraceous-tawny).

Type.— No. 67013, Am. Mus. Coll. Sacupana, Orinoco Delta, June 1896; Dr. H. H. Rusby. Wing, 100; tail, 140; bill, 18.5 mm.

Description of Type.— Above rich chestnut-brown (practically uniform from the forehead to the rump), tail with a purplish hue (wine color). Throat amber-brown; sides and breast buffy brown with drab suffusion, becoming darker on the belly and flanks, merging into bistre-brown on the under tail-coverts. This race is also near to typical *rutila*, but there is a less extension of the breast color over the belly and an almost total absence of the rufous suffusion seen on the flanks and crissum of *rutila rutila.*

Remarks.— Specimens examined: Two males from Villavicencio (eastern base of the Andes), Colombia; one female from La Union, Caura River, Venezuela, and the type.

The relationship to one another of the various races of *rutila* are indicated in the following synopsis:

a. Chin, throat and upper breast hazel-brown, followed by dusky buffy brown on the belly, flanks and crissum, and with bistre on the under tail-coverts, the whole with a distinct rufous suffusion . . . . *P. rutila rutila.*

Cayenne, the coast region and islands near the mouth of the Orinoco (Venezuela) and Trinidad.[1]

a′. An almost total absence of brown or rufous suffusion on the belly and crissum.
  b. Throat ochraceous-tawny.
    c. Breast paler, grayish drab (subterminal blackish bands on rectrices narrow). *P. rutila gracilis.*
      Ecuador: Esmeraldas; *Colombia:* Cali, La Manuelita, Rio Frio, Malena.
    c′. Breast and abdomen hair-brown; under tail-coverts slate-brown; subterminal blackish bands on rectrices broader, so that little rufous shows on under surface of tail .... *P. rutila panamensis.*
      Panama: Gatun, Canal Zone.
  b′. Throat darker, nearer hazel-brown.
    c. Back bright bay-brown (in some lights nearly a liver-brown). *P. rutila chaparensis.*
      Bolivia: Todos Santos, Rio Chaparé.
    c′. Back auburn-brown .... *P. rutila orinocensis.*
      Venezuela: Sacupano (Rio Orinoco), La Union (Rio Caura); *Colombia:* Villavicencio (base of Andes).

Capito dayi sp. nov.

Char. sp.— A *Capito* without streaks or spots in the plumage (either above or below), but with the feathers of the cheeks and throat tipped with narrow blackish bars producing a scale-like appearance. The entire top of the head bright scarlet-red in the males, black in the females.

Type.— ♀ ad., Porto Velho, Rio Madeira, April 3, Collins-Day Exp., Geo. K. Cherrie, No. 18359. Wing, 89; tail, 52; bill, 20 mm.

Description of type.— Above, including the sides of the head, lores and auriculars black; a white patch on the mantle formed by white scapulars; and a stripe on the wings where the innermost secondaries are marked with a yellowish white spot on their outer webs. Upper tail-coverts pale olive-green. Tail black. Chin, cheeks and throat tawny-olive, with slight vinaceous wash on the latter, where the feathers are tipped with narrow blackish bars giving the throat a scaled appearance. Lower throat, breast and middle line of belly buffy white shading into pale greenish yellow in centre of abdomen. Sides of breast (narrowly), sides, flanks (and extending over the sides of the lower breast and upper abdomen, except the middle line) deep black; thighs clear dull green. Under tail-coverts scarlet-red the longest ones tipped with dull green. Under wing-coverts and axillaries pale dusky olive-buff; a black spot at base of under primary coverts; inner edges of wing-quills pale olive-buff. Bill pale greenish gray; feet greenish plumbeous.

Remarks.— Adult male similar to the female, but with the forehead, crown and occiput bright scarlet-red; sides of head, superciliary streak, lores and auriculars black like the back and wings.

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[1] It is probable that the Trinidad birds are separable from those of the Orinoco coast region and Cayenne. The throat is paler and the back duller, less vivid, while there is a decided bronze wash extending across the tips of the secondaries to the tip of the wing, that is not seen in an example from Cayenne and another from Paloma Island, Orinoco Delta.

An immature male has the scarlet-red pileum of the adult, but the throat and breast are dusky vinaceous-buff, the cheeks only showing tawny olive similar to the adults. The blackish bars at the tips of the throat feathers (so conspicuous in the adults) entirely absent.

Five specimens from Porto Velho. There is also a specimen from Monte Cristo, Matto Grosso (Roosevelt Expedition).

Day's Barbet is dedicated to Lee Garnet Day, one of the leaders of the Collins-Day Expedition, a delightful camp companion and a valued friend.

Crocomorphus flavus inornata subsp. nov.

Char. subsp.— Similar to *C. flavus flavus* but outer surface of wing fuscous, the coverts only with narrow pale sandy-buff edges.

Type.— ♂, Santarem, Rio Tapajos, Brazil, April 17, 1915 (Geo. K. Cherrie, No. 18706), Collins-Day South American Expedition. Wing, 140; tail, 86; bill, 26 mm.

Remarks.— Chapman[1] and Hellmayr[2] have already called attention to the differences between the Amazonian birds and typical *flavus* of Cayenne. Four specimens secured by the writer at Santarem seem to point to the constancy of those differences for the birds of the Amazon Valley.

Hypocnemis collinsi[3] sp. nov.

Char. sp.— Similar to *H. flavescens flavescens* but brighter yellow below, with dusky edges to breast feathers nearly obsolete (breast not squamate). Sides of belly and flanks, back, rump and tail much less rufescent (being grayish olive-green).

Type.— ♂, Todos Santos, Rio Chaparé, Bolivia, March 14, 1915 (Geo. K. Cherrie, No. 18471). Wing, 51; tail, 41; bill, 16 mm. Feet greenish gray.

Description of type.— Above deep grayish olive; head black; superciliaries and a median stripe white, the latter formed by small white terminal spots to the black feathers; concealed dorsal spot pale ivory or marguerite-yellow, feathers in centre of mantle with broad black elliptical terminal spots and pale yellowish margins to inner webs, producing a streaked appearance; wing-coverts blackish with white terminal spots; below colonial-buff (Ridgway's Color Standards), sides of neck and breast with black striations; center of breast with black shaft-streaks (in one example the feathers narrowly edged with blackish giving a slightly squamate effect); flanks and crissum pale clay color, paler (buffier) in center of abdomen. Bill (in skin) above blackish, pale below; feet (in life) greenish gray.

Four specimens, including the type, taken at Todos Santos, Rio Chaparé, Bolivia.

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[1] *Celeus citrinus* Riker & Chapman, Auk, 1891, p. 31 (Santarem); Pelzeln, Zur Ornith. Bras., III, 1869, p. 252 (Borba, Rio Madeira).

[2] *Crocomorphus flavus* subsp. Hellmayr, Nov. Zool., XIV, 1907, p. 25 (Santarem); *id.* p. 80 (Teffé, Solimoes); *id.* p. 398 (Humaytha, Rio Madeira).

[3] I have pleasure in dedicating this race to my friend Mr. Alfred Collins of Philadephia who, with Mr. Lee Garnett Day, organized the Collins-Day Expedition.

Drymophila phantatis sp. nov.

Char. sp.— Similar to *P. caudata* but at once distinguished by a series of white spots (four) on both webs of the intermediæ in addition to the white tips, and in that the remaining tail-feathers are black (not grayish slate with a subterminal black bar) with white tips.

Type.— ♂, Jatumpampa (Cochabamba, Todos Santos Trail), Bolivia, Feb. 21, 1915, No. 18975, Geo. K. Cherrie. Wing, 52; tail. 70; bill, 12 mm. Feet gray; bill black above, pale below.

Description of type.— Above head, mantle and wing-coverts black with white striations on the two former, and white tips to the greater and middle coverts. On the crown and occiput the striations are produced by small narrow white spots (or lines) on the edges near the tips of the feathers, in the middle of the mantle the spots are much broader, and on the scapulars the outer webs are largely white; rump ochraceous-rufous; wings blackish, quills narrowly edged with pale rusty-grayish on outer webs, edging broader, more rusty and extending on to both webs on the tertials; tail black, tipped with white, the two center feathers with an additional four white spots along each web. Below throat and breast white; sides of throat and upper breast striated with black; chin and upper throat immaculate, center of upper breast with a few nearly obsolete blackish lines. Sides of belly, flanks and under tail-coverts bright clay color (with ochraceous-orange wash), middle of belly paler (buffy).

Formicivora rufa chapmani subsp. nov.

Char. subsp.— Similar to *F. rufa rufa* but darker, more rufous above, and the head distinctly streaked with blackish centers to the feathers in the males. The female is more heavily streaked with black.

Type.— ♂, Altar do Chao, Rio Tapajos, Brazil, April 15, 1915; Geo. K. Cherrie (No. 18674), Collins-Day Expedition. Wing, 53; tail, 54; bill, 13 mm.

Description of Type.— Above general color bright brown (Ridgway's Color Standards), but with less rufous on the head, the feathers of which are marked with blackish shaft-streaks; also some of the scapulars and back feathers show faint dusky or blackish shaft-stripes. The wings are blackish, the quills edged on outer webs with rufous. The greater wing-coverts are blackish with rufous wash on outer webs, middle and lesser coverts deep black. All the wing-coverts, including the primary coverts, with small rounded white apical spots. Tail black with slight rufous edges, at least basally, to the quills; and all, except intermediæ, tipped with white. The white superciliary streak is extended backward along the side of the neck and along the sides to the flanks. Sides of face, chin, throat, center of breast, and belly black. Flanks buffy buckthorn-brown.

Remarks.— The females of this race are more strikingly different from the females of *rufa rufa* than are the males, and may at once be recognized by the very much heavier black streaking on the underparts and the extension of that streaking on to the abdomen. The feathers of the throat might be described as black with white edges, whereas in *rufa rufa* the feathers are white with black shaft streaks. The upperparts are similar to those of the male, the head showing the same blackish central streaks on the feathers.

In both males and females of *r. rufa* the rectrices are marked with fairly well-defined subterminal blackish bands. In *r. chapmani* the black color following the white tip extends practically to the base of the feather.

In his observations on a collection of birds from Santarem Mr. Chapman[1] had called attention to some of the differences between a male of *F. rufa* from that locality and examples from Chapada, Matto Grosso. The birds secured at Altar do Chao, Tapajos River (twenty-five miles, more or less, above Santarem), exhibited not only the differences pointed out by Mr. Chapman, but other characters indicating that the birds found in the Santarem region constitute a very distinct race.

Mr. Chapman having been the first to note the differences between the bird here described and *F. rufa* I think it fitting that it should bear his name.

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[1] Auk, VIII, 1891, p. 29.

Article XXIV.— VOYAGE OF THE 'ALBATROSS' TO THE GULF OF CALIFORNIA IN 1911.

By Charles Haskins Townsend.

By a special arrangement with the United States Bureau of Fisheries, the American Museum of Natural History, The New York Zoölogical Society, the New York Botanical Garden and the United States National Museum, coöperated in a two months' voyage of the 'Albatross' in the Lower California region early in the year 1911.

Mr. Arthur Curtiss James, a Trustee of the American Museum, contributed $7,500 to the expedition. The Zoölogical Society and the Botanical Garden each contributed $1,000. The National Museum contributed the services of a naturalist. The Bureau of Fisheries furnished the 'Albatross,' with her officers and crew.

The various collections were to become the property of the institutions participating: all the preserved zoölogical collections to the American Museum, with a series to the National Museum; all the living specimens to the Zoölogical Society and the botanical collections to the Botanical Garden.

The Bureau of Fisheries desired information respecting the fish and fisheries and the oceanographical features of Lower California and the Gulf region, referring especially to the desirability of further knowledge regarding the supply of edible fishes, oysters and turtles, with the view to inaugurating a fish trade with our southwestern states.

The 'Albatross' being available for two months only, the voyage was accordingly arranged to include brief visits to as many different parts of the coast and islands as practicable, leaving time for considerable deep sea work during the return trip. The following itinerary shows that anchorages were made at thirty different points where marine and shore explorations were made:

Ports Visited	*Arrival*	*Departure*
San Francisco		Feb. 23
San Diego	Feb. 25	Feb. 28
Guadalupe Island	Mar. 2	Mar. 4
San Diego	Mar. 6	Mar. 7
San Benito Ids.	Mar. 9	Mar. 10
Cedros Island	Mar. 10	Mar. 12 (3 anchorages)
San Bartolome Bay	Mar. 13	Mar. 15
San Cristobal Bay	Mar. 15	Mar. 15

Ports Visited	*Arrival*	*Departure*	
San Roque Id.	Mar. 15	Mar. 15	
Abrejos Anchorage	Mar. 16	Mar. 16	
Santa Maria Bay	Mar. 18	Mar. 18	
Magdalena Bay	Mar. 18	Mar. 19	
Margarita Island	Mar. 19	Mar. 20	
Marcy Channel	Mar. 20	Mar. 21	
Cape San Lucas	Mar. 23	Mar. 25	
San Jose del Cabo	Mar. 25	Mar. 26	
La Paz (Pichiliuque Hbr.)	Mar. 27	Mar. 30	
San Josef Island	Mar. 30	Apr. 1	
Agua Verde Bay	Apr. 1	Apr. 2	
Carmen Island	Apr. 2	Apr. 3	
Mulege	Apr. 4	Apr. 5	
Concepcion Bay	Apr. 5	Apr. 8	(2 anchorages)
San Francisquito Bay	Apr. 9	Apr. 10	
Angel de la Guardia Id.	Apr. 10	Apr. 11	
Tiburon Id.	Apr. 11	Apr. 13	
San Esteban Id.	Apr. 13	Apr. 14	
Guaymas	Apr. 15	Apr. 15	
Santa Catalina Id.	Apr. 16	Apr. 16	
Santa Cruz Id.	Apr. 16	Apr. 16	
La Paz (Pichiliuque Hbr.)	Apr. 17	Apr. 19	
Espirito Santo Id.	Apr. 19	Apr. 19	
Ceralbo Island	Apr. 19	Apr. 19	
San Jose del Cabo	Apr. 20	Apr. 20	
San Bartolome Bay	Apr. 23	Apr. 23	
San Francisco	Apr. 28		

The zoölogical shore collections included 804 specimens of birds representing 143 different species; 259 specimens of mammals[1] of 59 species, ten of which proved to be new to science; 446 specimens of reptiles, of 47 species eight of which are new. A number of living reptiles were brought to the New York Zoölogical Park. A small but important series of insects was obtained and a very large collection of invertebrates.

The botanist, with assistance from the crew, made large gatherings of plants, obtaining about 1800 specimens. The collection of cacti was the most important of its kind ever brought from Lower California, and more than a thousand living specimens were sent safely to the New York Botanical Garden. Many of the plants have been described as new to science and there are many still to be studied. A short account of the botanical work by Dr. J. N. Rose appeared in the 'Journal' of the New York Botanical

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[1] See 'Mammals Collected in Lower California, with Descriptions of New Species,' by Charles Haskins Townsend. Bull. Amer. Mus. Nat. Hist., Vol. XXXI, Art. XIII, pp. 117–130, June 14, 1912.

Garden for December, 1911. Most of the century plants[1] brought back by the expedition proved to be new species.

The time spent at the various anchorages was usually one or two days, affording the scientific staff opportunity for making a natural history reconnaissance of the coastal region of the peninsula at many widely separated localities.

While in the Gulf of California the ship was usually moved at night so that the days could be largely devoted to shore work. Moving rapidly from point to point as we did, the shore work could not be extended very far inland, nor could the work of collecting be made very thorough, but the naturalists made the best possible use of each day ashore.

The active interest of Captain Burrage and the officers of the 'Albatross' contributed greatly to the effectiveness of our work, while the expedition would not of course, have been undertaken without the coöperation of the Bureau of Fisheries.

Dr. Hugh M. Smith, U. S. Commissioner of Fisheries, authorized the publication of the results of the expedition by the institutions participating.

In the oceanographic work, dredge hauls were made with the large beam trawl at 27 stations in depths ranging from 284 fathoms to 1760 fathoms, mostly off the west coast of Lower California. Following is a list of the stations occupied, with their positions and depths;

Dredging Stations	*Lat. & Long.*	*Date*	*Fathoms*	*Bottom Temp.*	
5673	31 26′ 00″ N. 117 42′ 00″ W.	Mar. 1	1090	....	
5674	31 28′ 45″ N. 117 09′ 50″ W.	Mar. 8	590	39.4	
5675	27 07′ 05″ N. 114 33′ 10″ W.	Mar. 15	284	44.6	
5676	25 31′ 15″ N. 113 29′ 30″ W.	Mar. 17	645	39.0	
5677	25 23′ 45″ N. 113 16′ 00″ W.	Mar. 17	735	38.6	
5678	24 35′ 20″ N. 111 59′ 35″ W.	Mar. 21	13½	....	(Magdalena Bay)
5679	23 47′ 45″ N. 111 23′ 00″ W.	Mar. 22	325	44.1	
5680	23 40′ 30″ N. 111 12′ 45″ W.	Mar. 22	389	43.6	
5681	23 33′ 15″ N. 111 02′ 10″ W.	Mar. 22	405	43.3	
5682	22 48′ 20″ N. 109 52′ 40″ W.	Mar. 24	491	40.8	
5683	22 46′ 45″ N. 109 50′ 15″ W.	Apr. 20	630	39.1	
5684	23 23′ 30″ N. 112 00′ 30″ W.	Apr. 21	1760	....	
5685	25 42′ 45″ N. 113 38′ 30″ W.	Apr. 22	645	....	
5686	26 14′ 00″ N. 114 00′ 00″ W.	Apr. 22	930	37.3	
5687	27 39′ 15″ N. 115 16′ 00″ W.	Apr. 23	480	41.1	
5688	27 38′ 45″ N. 115 17′ 40″ W.	Apr. 23	525	39.9	
5689	29 23′ 00″ N. 116 14′ 00″ W.	Apr. 24	879	....	

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[1] 'The Agaves of Lower California,' by William Trelease. Rept. Missouri Bot. Gard., 1911, pp. 37–65.

Dredging Stations	*Lat. & Long.*	*Date*	*Fathoms*	*Bottom Temp.*
5690	29 29′ 00″ N. 116 18′ 00″ W.	Apr. 24	1101	38.1
5691	31 08′ 20″ N. 118 29′ 30″ W.	Apr. 25	868	37.2
5692	31 23′ 45″ N. 118 31′ 30″ W.	Apr. 25	1076	37.1
5693	33 13′ 30″ N. 120 04′ 30″ W.	Apr. 26	451	....
5694	33 24′ 36″ N. 120 12′ 30″ W.	Apr. 26	640	....
5695	33 33′ 00″ N. 120 17′ 30″ W.	Apr. 26	534	38.9
5696	35 18′ 30″ N. 121 28′ 00″ W.	Apr. 27	440	39.9
5697	35 35′ 00″ N. 121 39′ 00″ W.	Apr. 27	485	39.8
5698	35 50′ 00″ N. 121 49′ 30″ W.	Apr. 27	475	39.9
5699	36 00′ 30″ N. 122 00′ 00″ W.	Apr. 27	659	37.9

The hydrographic observations connected with this work are presented in detail elsewhere in this report, and all sea and shore stations are indicated on the accompanying chart.

The dredgings were rich in new and interesting forms. Among the more striking results of this work for museum purposes, were fifty casts of deep sea fishes made on board from freshly dredged specimens, by Mr. J. C. Bell. In these casts the following twenty-two genera are represented:

Venefica
Narcetes
Halosaurus
Porogadus
Macrurus
Chaunax
Malthopsis
Antimora
Raia
Liparis
Nemichthys
Pleuronectes
Monomitopus
Phycis
Merlucius
Lycodes
Argyropelecus
Leucicoris
Alepocephalus
Sebastolobus
Melamphæs
Scopelengys

The last (*Scopelengys*) was dredged from a depth of 1760 fathoms.

Of the deep sea collections, only the echinoderms[1] have as yet been studied. The latter consist of 1881 specimens, representing 107 species, seven of which were previously unknown; namely:

Zoroaster platyacanthus
Pedicellaster hyperoncus
Diopederma axiologum
Ophiura oligopora
Urechinus recticulatus
Lætmenœcus scotoeides
Stichopus parvimensis

The collection of fishes obtained by the Albatross was a large one. The deep sea species have not yet been studied. The collection of shore fishes[2] contains 185 species of which the following 15 have been described as new:

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[1] Echinoderms from Lower California, with Descriptions of new Species. By Hubert Lyman Clark. Bull. Am. Mus. Nat. Hist., Vol. XXXII, Art. viii, pp. 185–236. July 9, 1913.

[2] Shore Fishes Collected by the 'Albatross' Expedition in Lower California with Descriptions of New Species. By Raymond C. Osburn and John Treadwell Nichols. Bull. Am. Mus. Nat. Hist., Vol. XXXV, Art. xvi, pp. 139–181, May 26, 1916.

Raja microtrachys
Urobatis concentricus
Letharchus pacificus
Bascanichthys bascanoides
Fundulus parvipinnis, sub sp. brevis
Tylosurus pterurus
Siphostoma exile
Atherinopsis sonoræ
Amia guadalupensis
Girella simplicidens
Hermosilla robusta
Callyodon compressus
Callyodon microps
Dactyloscopus cinctus
Lucioblennius lucius

Most of the collection was obtained along the shores and about the islands, the deeper parts of the Gulf being muddy and apparently poor in fish life as shown by previous dredgings by the ‘Albatross.’

The peninsula of Lower California is nearly 800 miles in length, with an average width of 60 or 70 miles. It is a mountainous region, having a central elevation, near the northern end, of over 10,000 feet.

The climate is almost rainless and the country as a whole is of desert character. Less than a hundred springs and streams have been described and of the latter only five or six flow permanently to the coast. Populated localities are necessarily located with reference to the limited supplies of water.

Lower California is rich in mineral resources but these remain undeveloped except in a few localities where sufficient water is obtainable. Agriculture is practiced under the same limitations as mining. The fishery resources are important but have as yet been but little drawn upon.

Zoölogically and botanically the region is of great interest to naturalists. Climatically it belongs to the Sonoran province of the temperate realm, usually described as arid. The fauna of the extreme southern end has many tropical characteristics, while much of the fauna and flora of the northern end is related to southern California.

The climate of the eastern side of the peninsula is warmer than that of the western side. Observations made on board the Albatross during the cruise along the west coast of the Peninsula from March 1 to 25 and from April 20 to 29, give the mean temperature of the air as 61° Fahr. and of the water at the surface 60°. While cruising in the Gulf of California from March 26 to April 20, the mean temperature of the air was 71° and of the water 68°.

Narrative. The steamer ‘Albatross’ left San Francisco at 9.30 A. M., February 23, 1911, under the command of Commander G. H. Burrage, U. S. N., who had instructions from the Bureau of Fisheries to proceed to San Diego and report for work during the months of March and April in the Lower California Region.

The vessel arrived at San Diego at noon on the 25th of February, where our party joined her. These were C. H. Townsend, Director, Dr. J. N. Rose, Botanist, Dr. Paul Bartsch, Conchologist, H. E. Anthony, Collector, P. I. Osburn, Collector, and James Bell, Modeler. Messrs. L. M. Tongue and W. L. Schmitt of the Fisheries Bureau were also with the expedition. After coaling and taking on supplies, the 'Albatross' sailed on the evening of the 28th, the course being laid for Guadalupe Island.

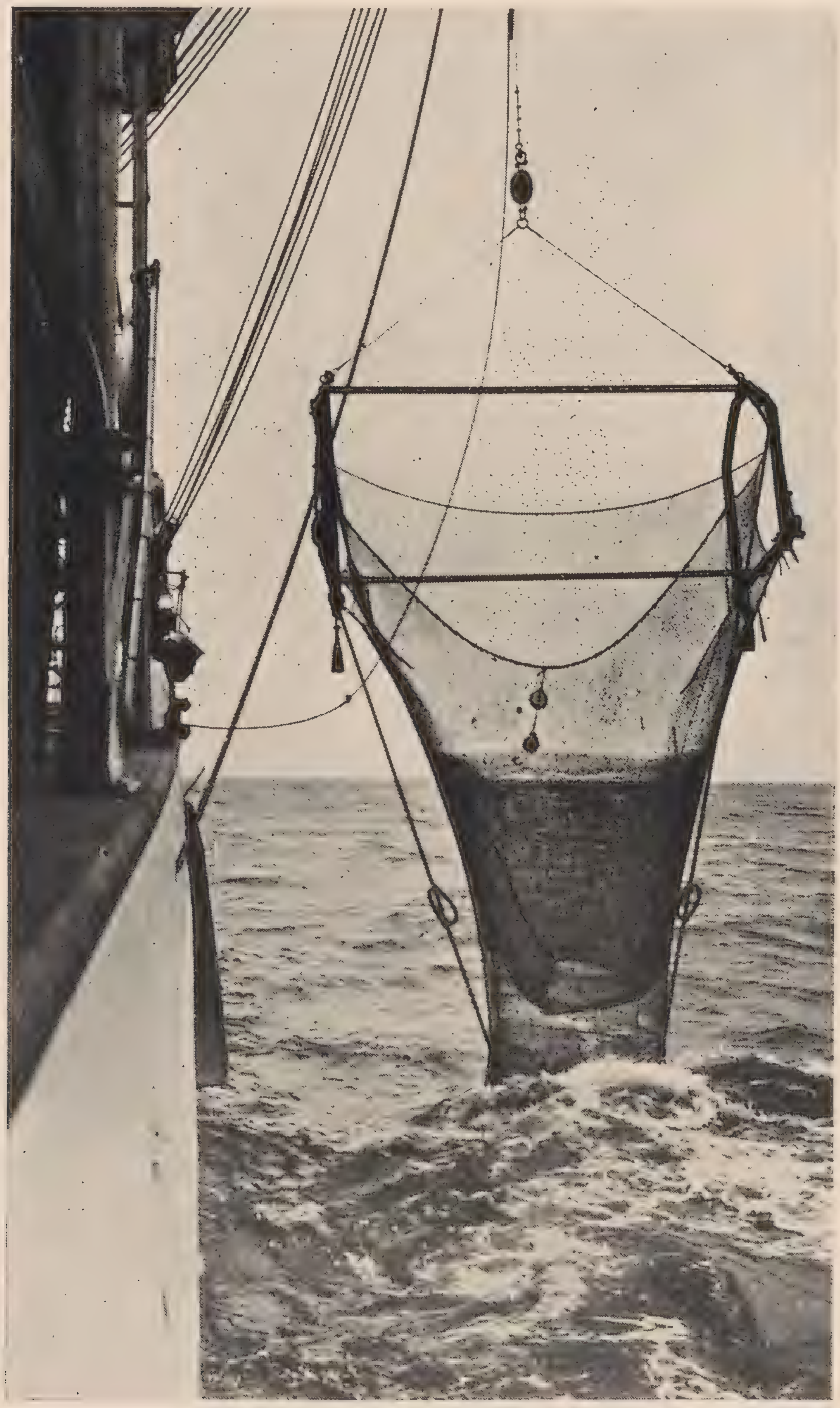

Fig. 1. The beam trawl of the 'Albatross' coming up with a load from deep water.

The following day a haul of the dredge was made in 1090 fathoms (Sta.

5673). The catch consisted of two fishes and numerous invertebrates, with about two barrels of stiff blue mud. The animal forms were roughly identified as follows: Fishes — 1 *Macrurus,* 1 *Raia;* Starfishes: *Eremicaster pacificus* and *Pectinaster agassizii.* Shells — *Trophon, Hemicardium,* 8 brachiopods, 8 *Dentalia;* Crustacea — 3 species of crimson prawns; miscellaneous — worms, ophiurans, holothurians, ascidians, silicious sponges, 1 very large pycnogonid, ophiurans and worms in tubes by hundreds. The blue mud obtained here proved to be interesting. Our modeler was in need of modeler's clay, of which we had but a small supply. With a little working by hand, the bluish, stiff mud from this and other dredging stations in this general region, could be made equal to the best modeler's clay. It was used constantly as a modeling clay on board the ship and was not distinguishable from the commercial article.

We arrived at Guadalupe Island on the morning of March 2, where the scientific staff was landed at the deserted camp near the northeast point. I started with the ship at once for the northwest side to examine the site of an old rookery of elephant seals which I had visited in 1892. At that time I was in charge of the schooner 'Santa Barbara,' making a reconnaissance of Guadalupe Island for the Department of State with a view to identifying the species of fur seal known to exist there. Two miles west of North Point I took a boat and began examining the coast, the 'Albatross' keeping off shore. I followed along the beach just outside of the breakers for a couple of hours to within two miles of Steamer Point, where I found about one hundred elephant seals hauled out on the sand beach below the cliffs and between two large rock slides. I killed one large male and one large female, which were skinned and taken on board at nightfall, along with six live yearlings. Early in the afternoon the ship left us some men, and returned to the east side to pick up the party landed there in the morning. On her return at dusk, she anchored about half a mile off the elephant seal beach in fifteen fathoms, where we spent the night.

The following day the sea was too rough for landing. We remained at anchor and spent the day in preparing the two large skins for museum purposes; our collectors working on the birds, plants, and other specimens obtained on the east side of the island the day before. Among the birds collected were the Guadalupe house finch, wren and snowbird. The goldfinch was observed. Nothing was seen of the Guadalupe flicker, which is believed to have been exterminated by former collectors. Several petrels were captured on board during the two nights we were anchored off elephant beach.

The beach occupied at present by the elephant seals is five or six hundred yards in length, and is not accessible from the island at any point. The

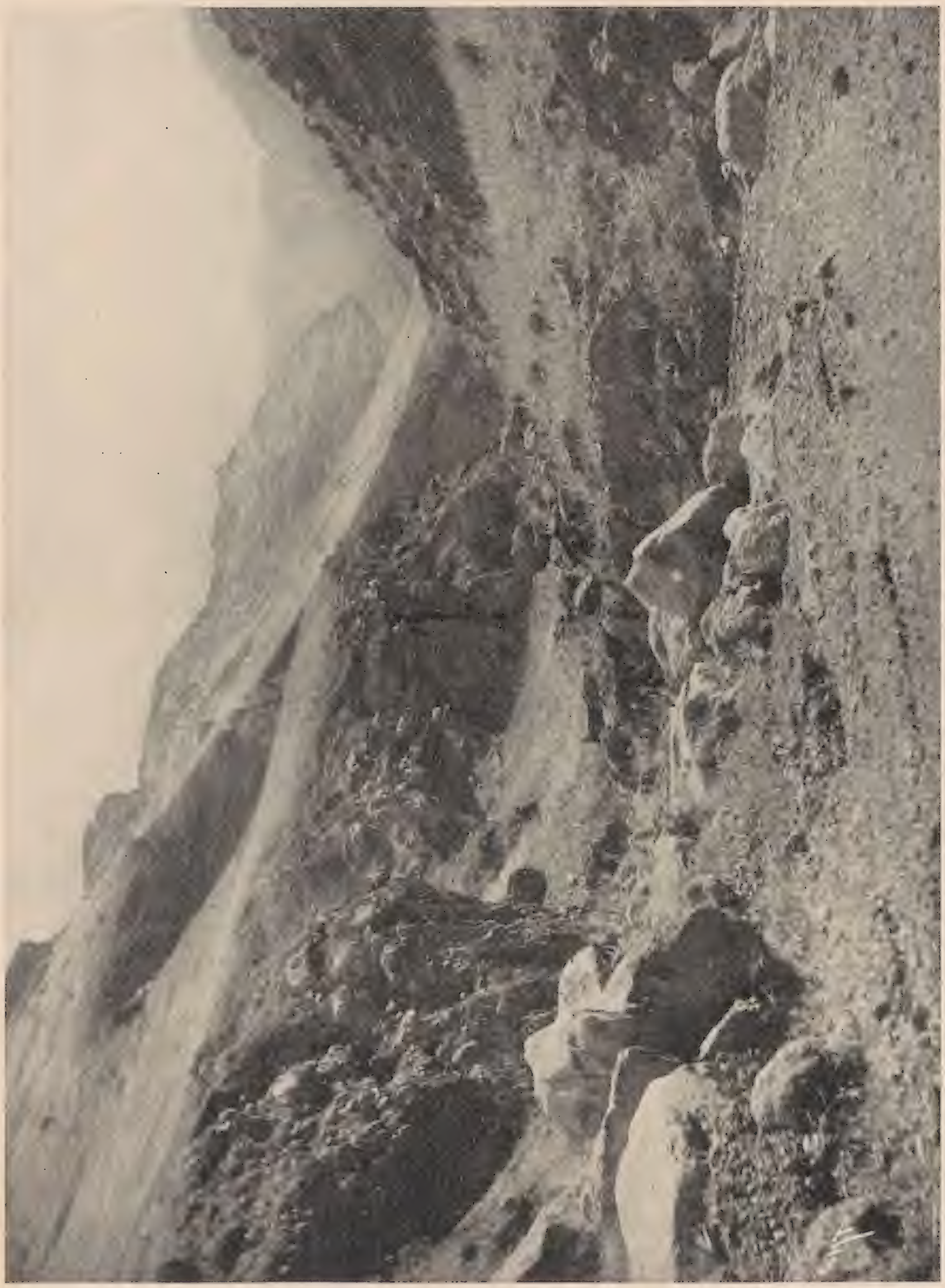

Fig. 2. Cañon at the northeast landing, Guadalupe Island, L. C.

morning of the 4th, I landed and shot two more of the large elephant seals. We spent the forenoon and half of the afternoon in skinning and skeletonizing these, several men working on the large heavy specimens. Each of the large males killed measured sixteen feet in length. Our operations caused very little disturbance of the rookeries; one large male remaining within thirty feet of where we were working. A few of the elephant seals left the beach, but the most of these soon returned and probably none of them would have moved if they had not been annoyed by the sailors walking among them.

The six yearlings taken the day before were captured by simply winding them up in nets to prevent them from biting, or escaping from the boats. I secured about fifty good negatives, showing the seals in various attitudes and the general character of the rookery. There was ample proof that this was the commencement of the breeding season; a dozen or more of the females being accompanied by very young pups. The latter were very dark colored and quite distinct in size from those of the apparently yearling class which we had captured alive. They were remarkably fat and almost incapable of movement on that account. Later in the afternoon before we sailed, I examined the shore line for a couple of miles south of Steamer Point, where I had observed fur seals in 1892, but found no signs of them. The Guadalupe fur seal (*Arctocephalus townsendi* Merriam) may be extinct. If there are any individuals left they probably occupy some of the numerous beach caves farther south, as it was the habit of the species to lie in such shelters.

Guadalupe Island is about 20 miles long and from 3 to 7 miles wide. It is 4500 feet high near the northern end and is of volcanic origin. The island is overrun with goats, which have contributed greatly to its barrenness. Although formerly used as a goat range, the animals being raised for their skins only, it has long been uninhabited. There are a few scattered cypresses, pines and cabbage palms about the higher elevations, and a few springs some of which fail in dry seasons.

Fishing at the elephant-beach anchorage was good, but the fishing ground about the island is limited, as it is surrounded by very deep water.

At nightfall the 'Albatross' sailed for San Diego in order that the young elephant seals and the large skins might be shipped eastward without delay. The entire following day was spent in cleaning and preparing the skins and skeletons of our four large specimens for shipment. We arrived at San Diego on the morning of the 6th. The young elephant seals were each crated separately and forwarded by express to the New York Aquarium, without food or water, as they would not eat and were in good condition. Later two of them were sent to the Zoölogical Park in Washington.[1]

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[1] The writer has published a special account of the elephant seal in 'Zoologica,' Scientific Contributions of the New York Zoölogical Society, I, No. 8, pp. 159–173, pll. 52–72, April, 1912. He has also published an article on the same subject in the 'Century Magazine' for June, 1912, pp. 205–211.

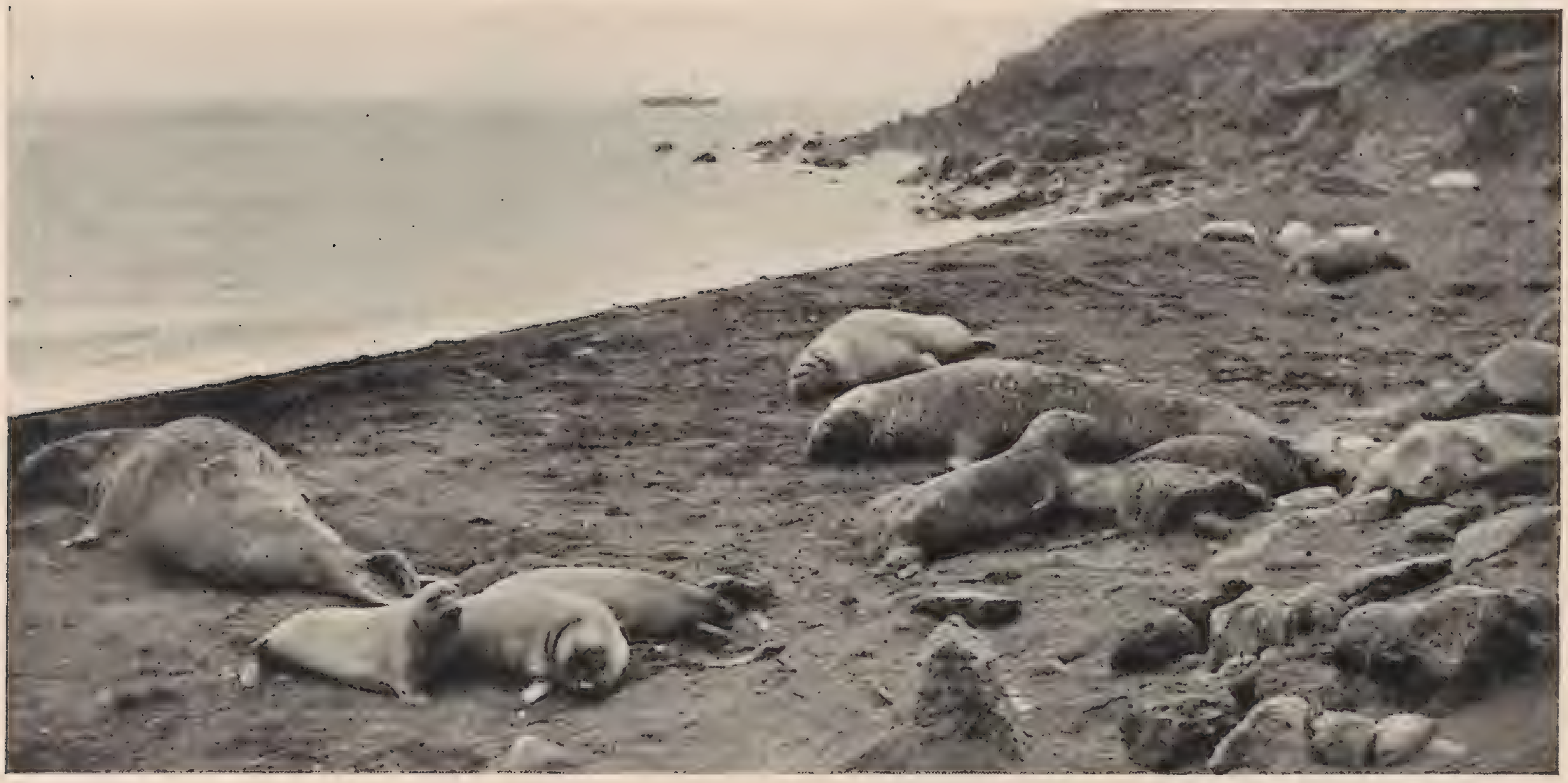

Fig. 3. Elephant Seals. Guadalupe Island.

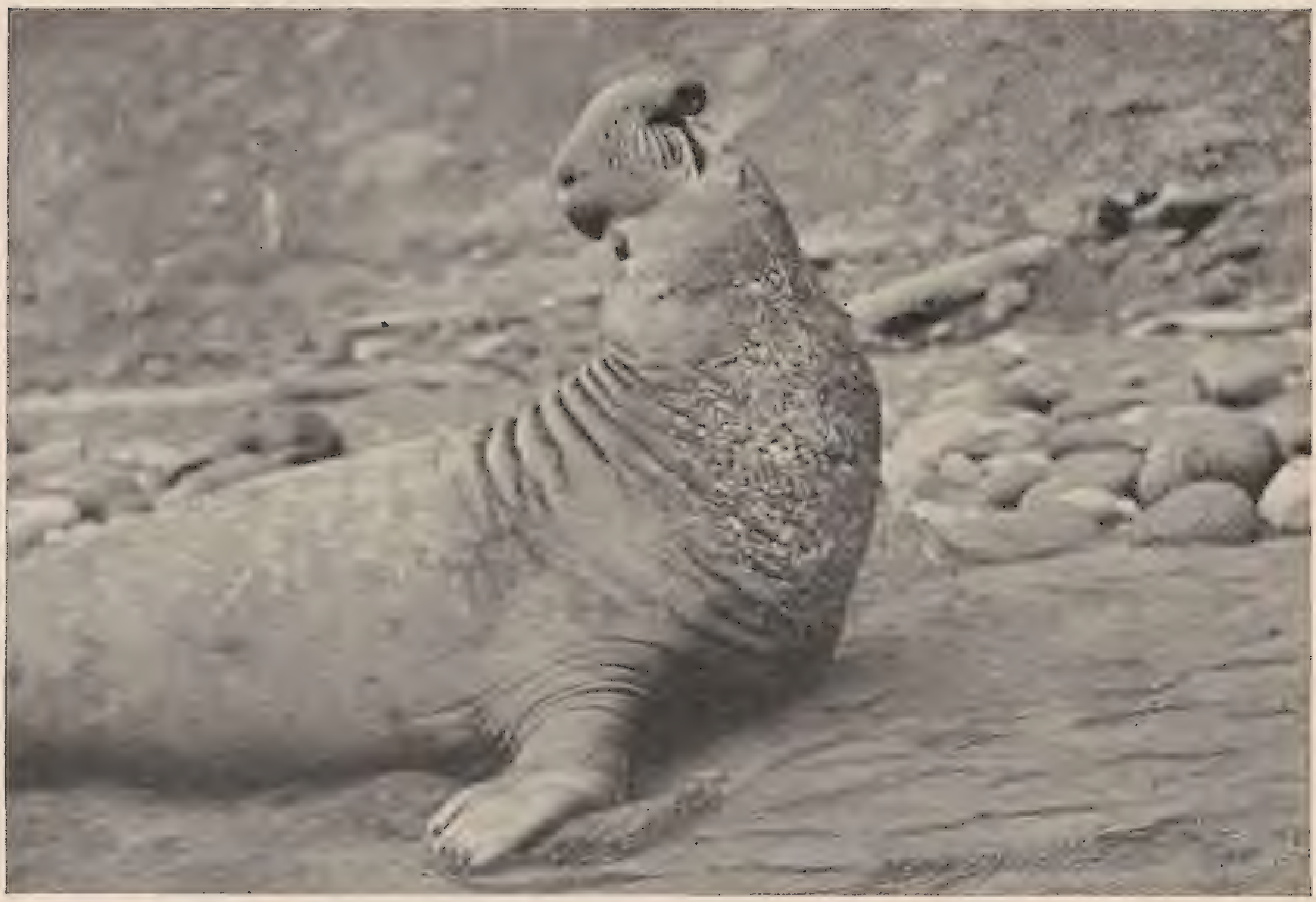

Fig. 4. Old male Elephant Seal. Guadalupe Island.

The 'Albatross' sailed southward in the evening. The following morning we dredged in 590 fathoms (Sta. 5674). The haul was a small but clean one, there being merely a handful of blue mud. The catch was as follows: Fishes — 1 *Stemonidium,* 1 *Cyclothone,* 2 *Melamphæs;* Invertebrates — 1 crimson prawn; schizopod, 1 starfish, and a few salpæ. This was a clean haul with only a handful of blue mud. It is interesting to note that all the fishes came up *alive,* an unusual occurrence from such a depth.

We arrived at the San Benito Islands early on the morning of the 9th. I examined carefully the north and east shores of West Benito in search of the fur seal which formerly existed there. There was a rookery of about one thousand sea-lions (*Zalophus californianus*) on the west side, extending fully half a mile along the rocks. It was evidently not the breeding season of the California sea-lion, as no pups were seen. Many weathered heaps of abalone shells were observed along the north shore, where formerly Chinese were engaged in drying abalone meat. Nests of the osprey, composed of dried sea weed, were observed on low rock pinnacles, about half of them containing sets of three eggs. As only one young osprey was observed, the nesting season was evidently not far advanced.

In the afternoon I examined the eastern shore of East Benito, looking over several small sea-lion rookeries in my search for the fur seal. There appeared to be about seven hundred sea-lions on this island. The collectors worked on both islands obtaining lizards, plants, fishes and invertebrates. Among the birds obtained were San Benito sparrow, MacGregor's house finch, sparrow hawk, rock wren, burrowing owl, osprey, oystercatcher, gull, duck hawk, hummingbird, horned lark, cormorant and Cassin's auklet. The surface of parts of East Benito was so riddled with the burrows of auklets that it was difficult to walk without breaking into them. A new species of century plant found at the San Benitos has been named *Agave disjuncta.*

We sailed early on the morning of the 10th for South Bay, Cedros Island. This locality has a much scantier vegetation than other parts of the island. The weather was extremely rough for landing. The collectors obtained comparatively little; the land birds being represented by sparrow and hummingbird only. Osprey eggs were brought on board, and gulls, cormorants and terns were seen. A few of the land birds observed were horned lark, house finch, Say's flycatcher, raven and vulture. Black-chinned hummingbirds were numerous. The collection of plants was good, and one species of mouse (*Peromyscus eremicus cedroscensis*) was obtained.

On the 11th the 'Albatross' arrived at the watering place on the southeast side of Cedros where the collectors were all landed. Birds were not abundant but a few species of land birds were obtained. The collection of plants and lizards was more important. A few mice were taken and a single frog was captured at the spring. Work with the seine was more profitable and a good variety of fishes was obtained. Smelts and anchovies of excellent quality were very abundant, a few sweeps of the seine yielding more than a barrel of them.

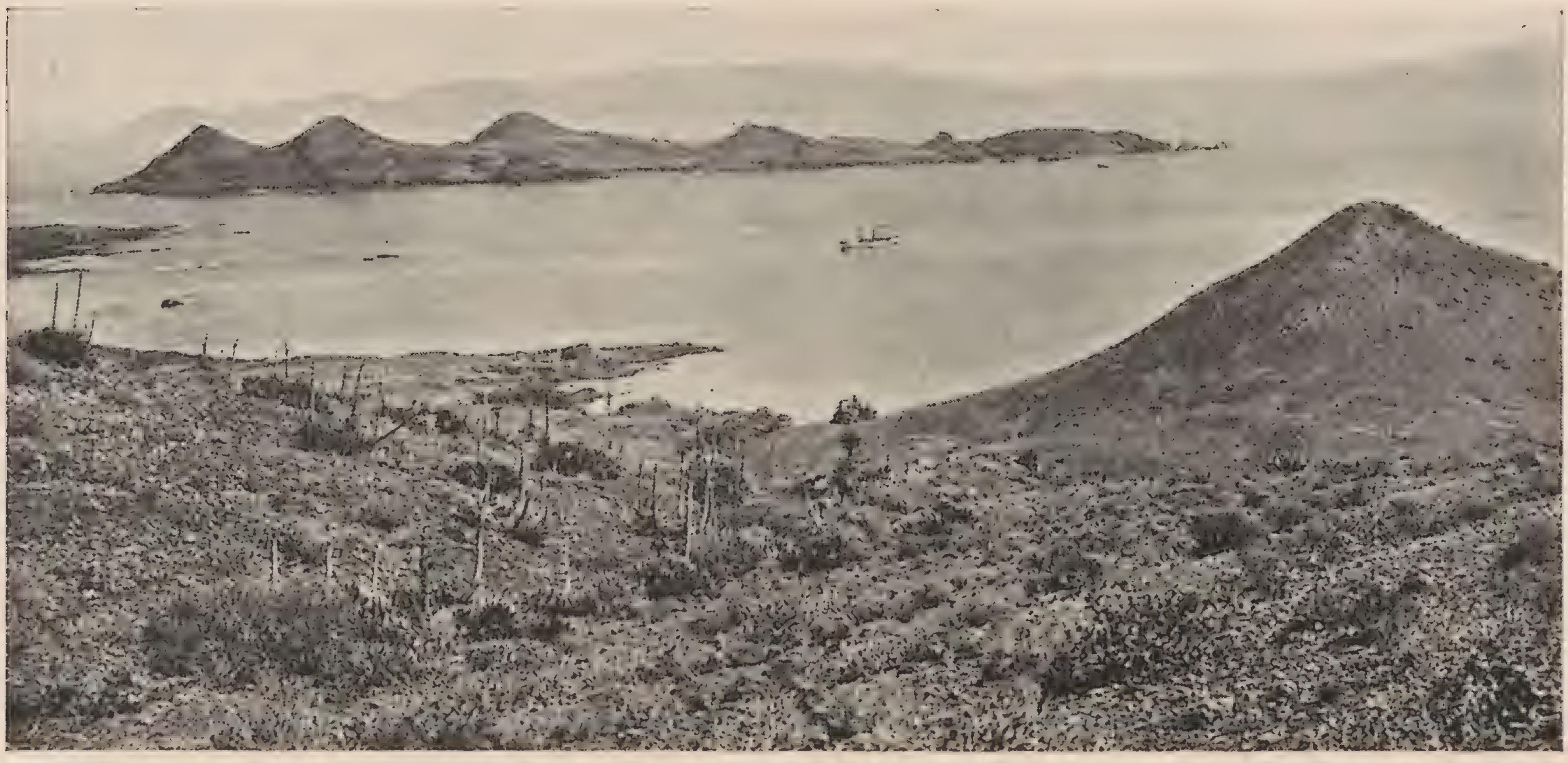

Fig. 5. The 'Albatross' anchored between east and west San Benito Islands. Century plants (*Agave*) in foreground.

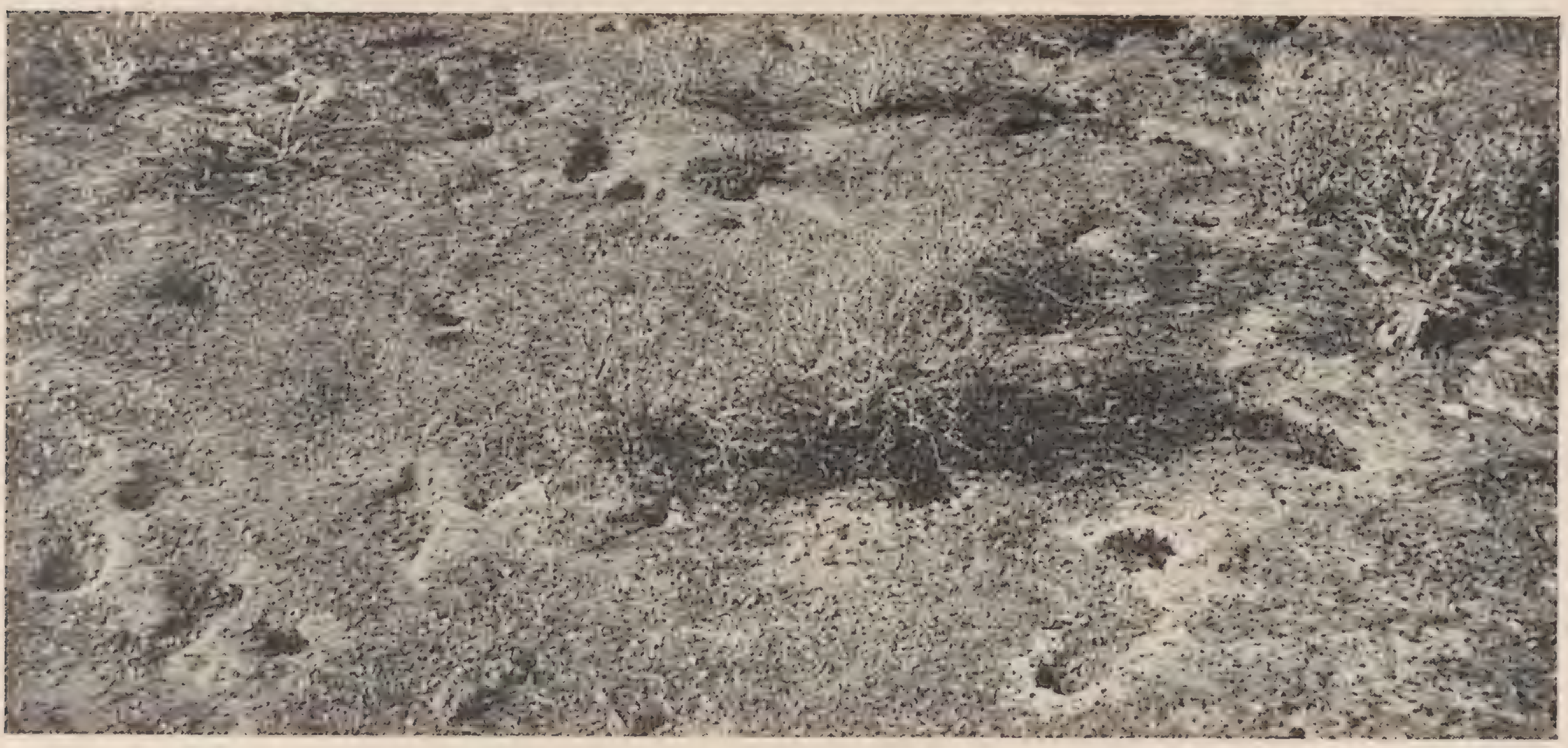

Fig. 6. Burrows of petrels. East San Benito Island.

The spring at this anchorage is the only place where fresh water can be obtained near the beach in this region of Lower California. The water is somewhat charged with sulphuretted hydrogen and has a very distinct odor.

On the morning of the 11th we arrived at the central part of the east side of Cedros and anchored opposite a beach at the foot of a wide, flat valley leading into the interior. The collectors followed up the valley, some of them climbing the high central ridge, covered with cedar trees, about four miles inland. About three miles inland the winding valley opened out into an amphitheatre, at the upper end of which is a spring of water where the main valley forks. This valley is the best route to the interior of the island. The spring water here also smelled and tasted of sulphur and left a whitish deposit on the ground. This is the only fresh water in this part of the island.

A good collection of birds, lizards and plants was obtained. The seining party got fishes similar to those obtained at the last anchorage. Photographs were taken of plants and scenery. I procured a fourteen-inch lizard which had swallowed a ten-inch lizard. There were no snakes seen. Among the birds taken were finches, two species of hummingbird, burrowing owl, gnatcatcher, Audubon's warbler and wren. A few wild mice (*Peromyscus eremicus cedroscensis*) were taken in the traps.

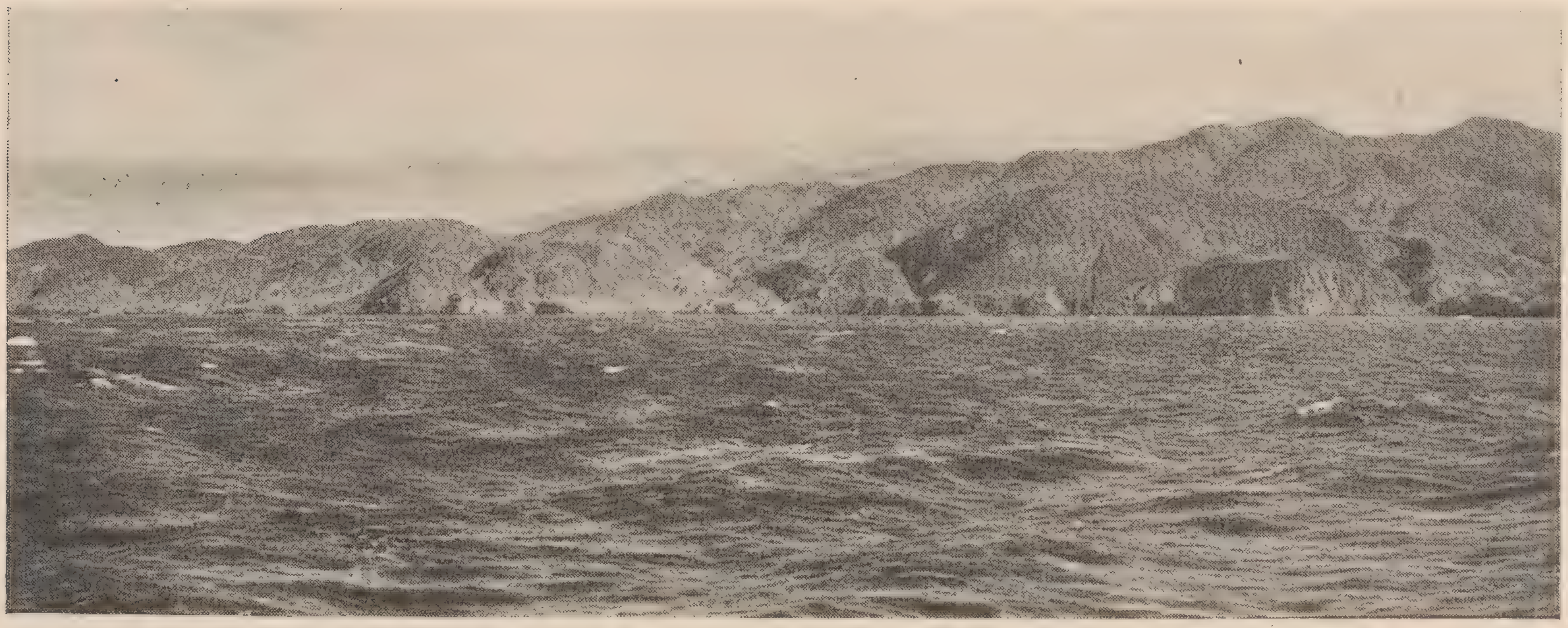

Fig. 7. The barren southern end of Cedros Island.

A very interesting feature of the plant life of Cedros Island is the strange elephant tree (*Pachycormus discolor*) which takes a thick bush-like form. It sometimes reaches a height of twenty feet, with a spread of forty. The main stem may be more than a foot thick at the ground, and branches immediately into several arms, the branches are exceedingly thick and heavy and the bark, sometimes an inch in thickness, is a soft pulpy rind which may be cut readily with a penknife. The elephant tree is a monstrous growth in appearance and is commonly found on the lower hillsides and in the cañons. It is also found on the mainland. (See Fig. 10.)

The seining party obtained a good variety of fishes and the boat dredge

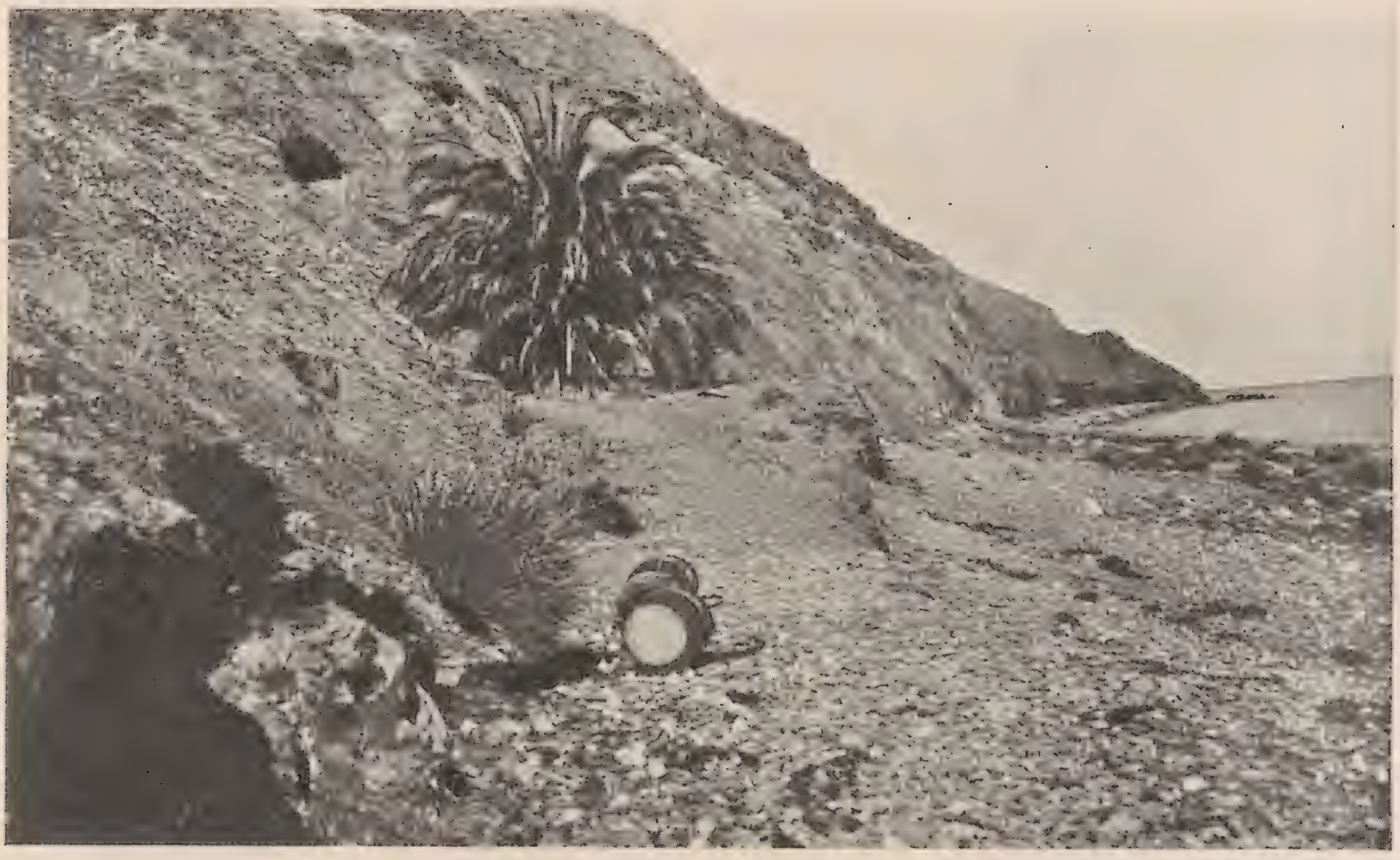

Fig. 8. Watering place, southeast side of Cedros Island.

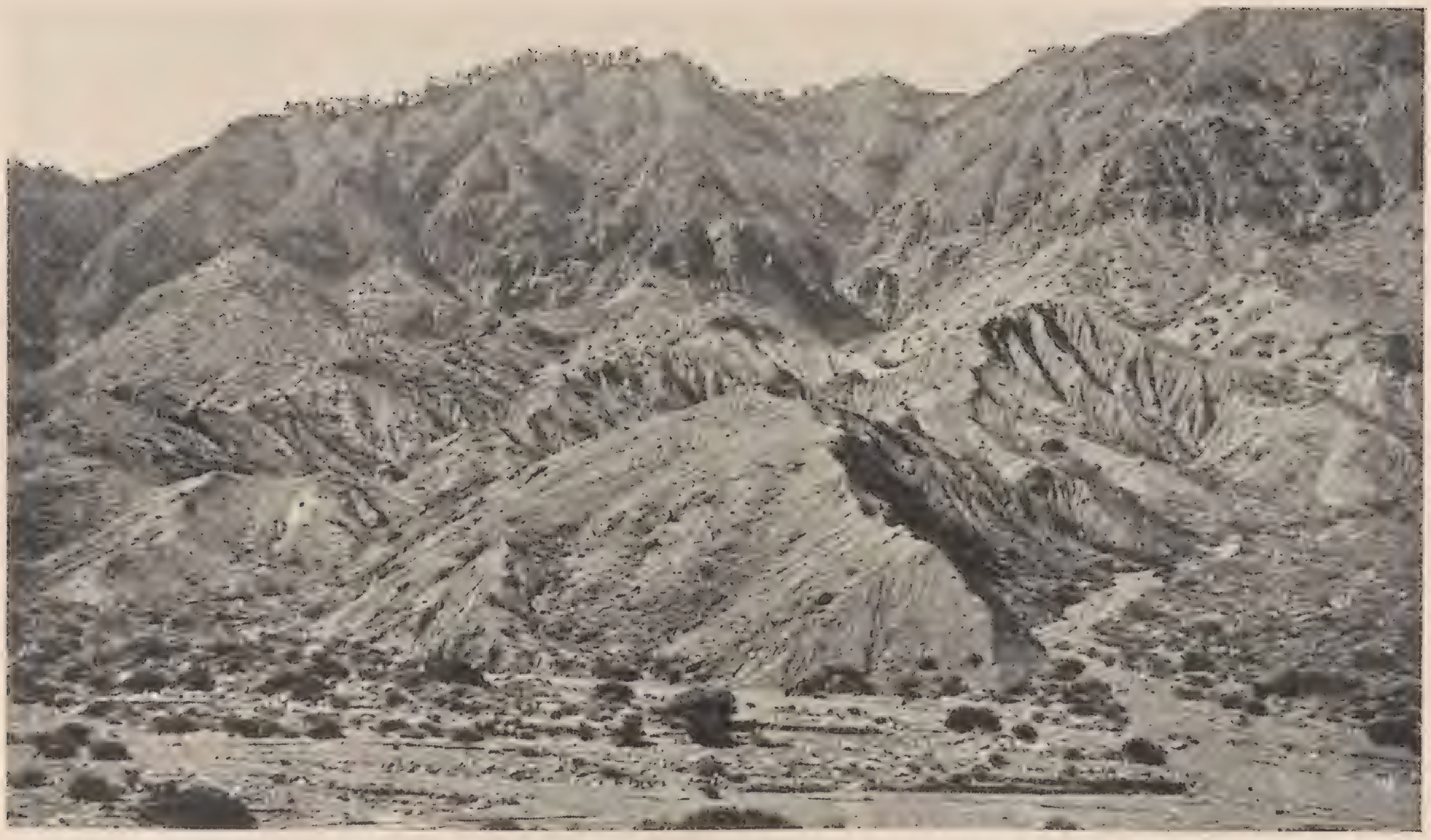

Fig. 9. Head of the central valley of Cedros Island, showing on high central ridge, the cedars from which the island derives its name.

was towed by the launch with fair success. Cedros, like nearly all of the islands off Lower California, is uninhabited.

Sailing in the evening we arrived at San Bartolomé Bay, on the Peninsula, on the morning of the 13th. Here we found two camps of fishermen engaged in catching spiny lobsters (*Panulirus*), for the San Diego and Los Angeles markets. They supplied us most liberally with green turtles and lobsters in exchange for a barrel of fresh water in order to save themselves a 35-mile voyage to Cedros Island, the nearest place for fresh water.

An account of this lobster fishery will be found under another heading. Green turtles are very abundant here, and "Turtle Bay" is one of the names used for this locality. This was our first working place on the Peninsula and the scientific staff made the most of our two days' stay. We obtained specimens of coyote (*Canis peninsulæ*), deer (*Odocoileus hemionus peninsulæ*), woodrats (*Neotoma intermedia gilva*) and mice (*Perognathus penicillatus arenarius, P. fallax,* and *Peromyscus maniculatus coolidgi*). The birds included both water and land forms but the latter, as on the islands we had visited, were not very abundant or of many varieties. Among the species obtained were the large-billed sparrow, sage thrush, horned lark, wren and golden-crowned sparrow. Water birds were quite abundant, there being large rookeries of pelicans and cormorants at the entrance of the bay. Porpoises are common in the bay and we obtained one skull of *Tursiops gilli* on the beach.

The entire coastal region of Lower California is desert-like in character, as also are the outlying islands. The vegetation is low and brushy. As rain seldom falls, nearly all the vegetation has a decidedly dry and scorched appearance. The boat dredge was used successfully and the seining party obtained fishes in abundance and variety. Two large California jewfish (*Stereolepis gigas*) were taken at the anchorage. They weighed 138 and 204 pounds respectively.

Leaving on the morning of the 15th, we proceeded twenty miles south to San Cristobal Bay, where in 1884 I had obtained specimens of elephant seal for the National Museum when I was in charge of the schooner 'Laura.' While the 'Albatross' lay off shore I examined the beach for several miles from the steam launch at close range, but there were no signs whatever of elephant seals. A large California jewfish was taken at the anchorage. We moved off shore in the afternoon and dredged in 284 fathoms (Sta. 5675), making a good haul of fishes and invertebrates which were listed as follows: Fishes — 18 sharks (1 species, the largest being 18 feet long), 59 macrurids of 3 species, 1 *Nemichthys,* and two other species; invertebrates — 2 quarts of small grayish echini, 2 dozen anemones, 25 holothurians, 3 species of starfishes (*Pseudarchaster pusillus, Ceramaster leptoceramus,* and *Zoroaster*

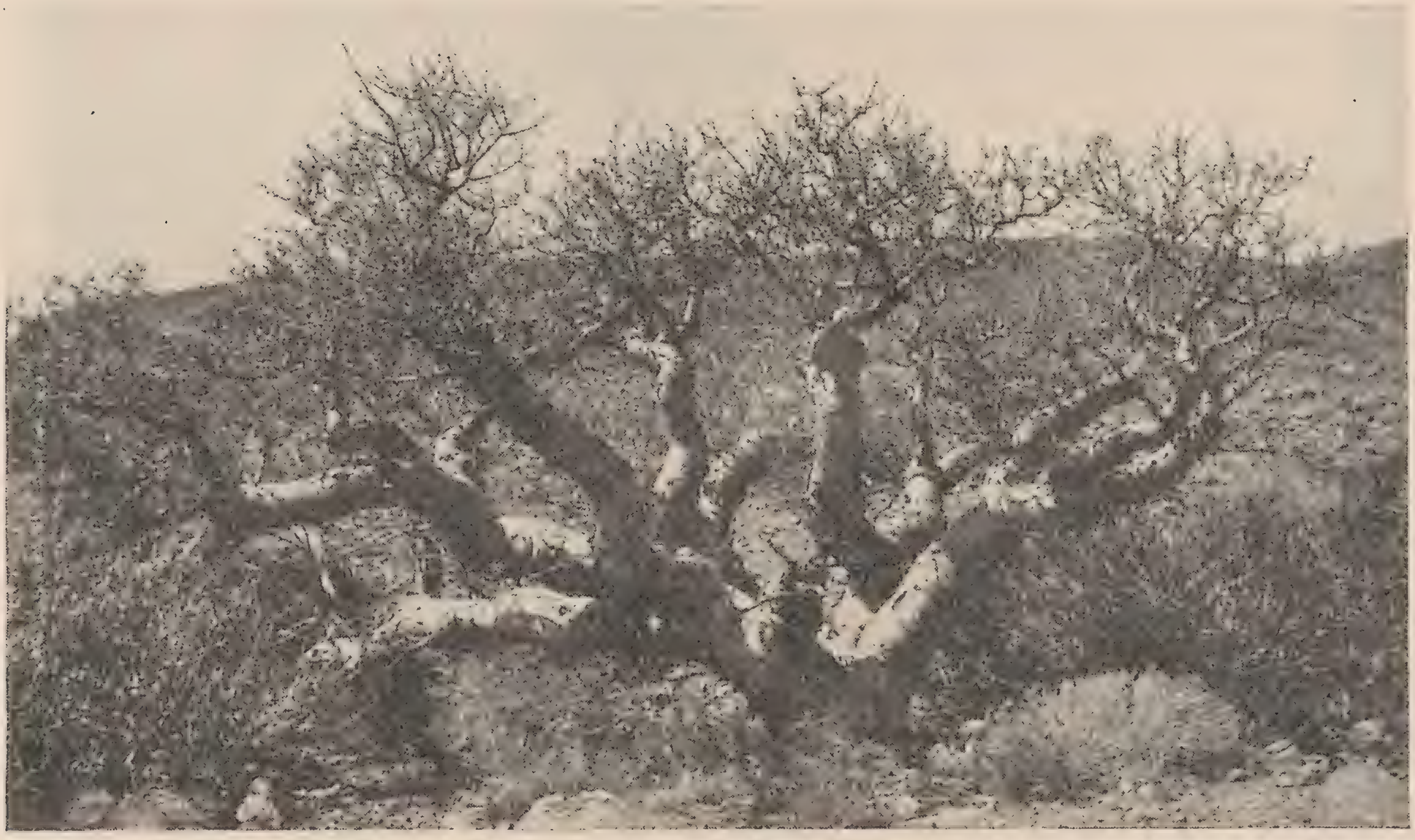

Fig. 10. Elephant Tree (*Pachycormus discolor*). San Bartolome Bay, Lower California.

Fig. 11. Seining party from the 'Albatross.' San Bartolome Bay, Lower California.

platyacanthus), 5 species of crustaceans, 25 ascidians, many *Nassa*, 4 *Amphitrite*, several Ophiurans, worms and numerous sea urchins (*Brissopsis pacifica*).

At five P.M. we landed on San Roque Island where collecting was carried on until dark. The island has rookeries of gulls, cormorants and pelicans. A few ospreys were seen about their nests. The soil of the island appears to contain considerable guano and the soft ground is riddled with the burrows of petrels and auklets. Steaming slowly during the night the 'Albatross' arrived at Abreojos Point, Ballenas Bay, on the morning of the 16th. The desert vegetation was sparse, dried up and much of it appeared dead although merely dormant. The locality was the most barren desert we had yet seen and there were no signs of fresh water. The seine hauls yielded about half a barrel of large kingfish, as many young kingfish, a few flounders, smelts and anchovies. The beach was lined with rows of clam and other shells. Gulls and cormorants were abundant and a few sea lions were seen about the Point.

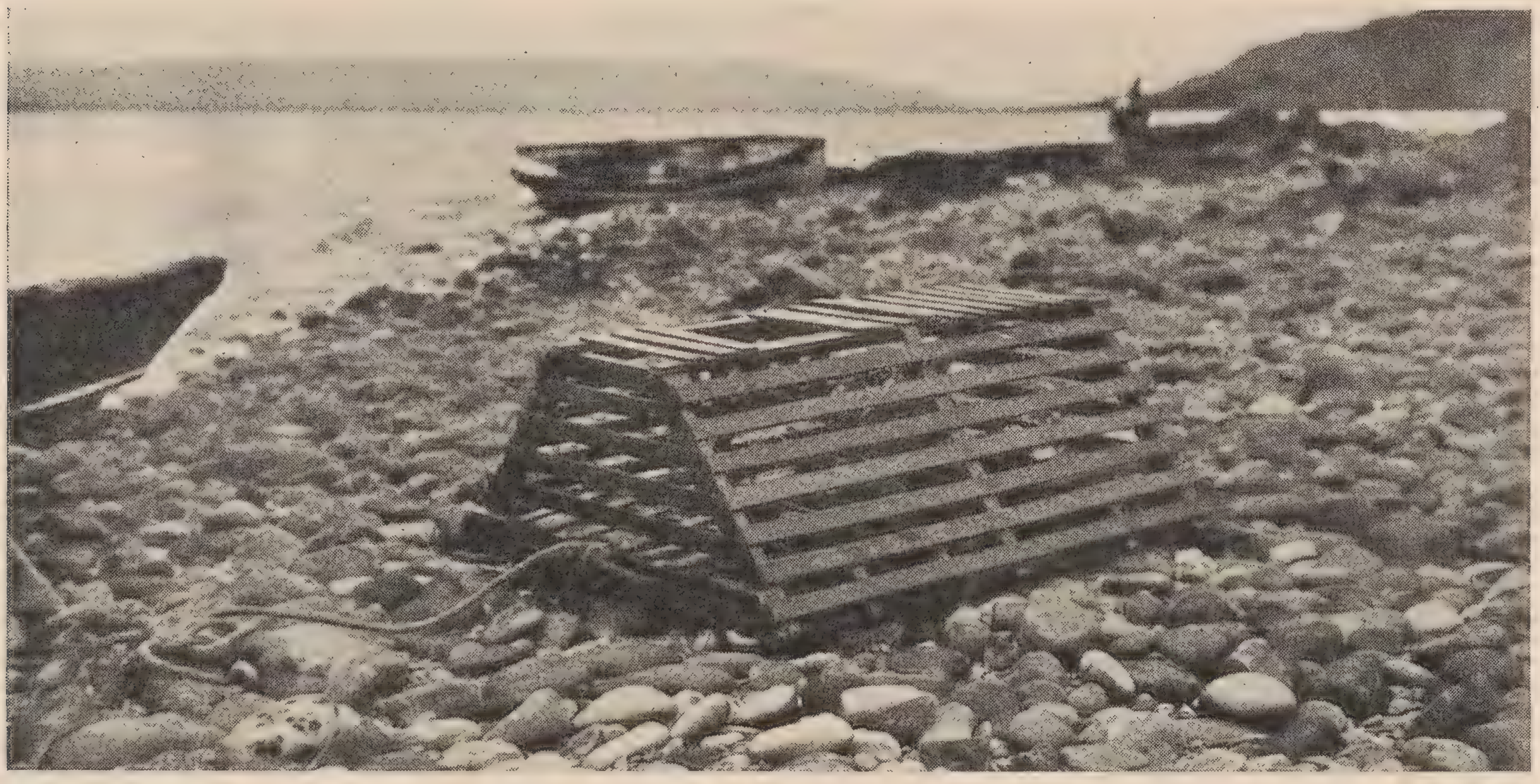

Fig. 12. Pattern of lobster pot used at San Bartolome Bay.

Sailing in the evening, we dredged the following morning in 645 fathoms (Sta. 5676), obtaining fishes and a good variety of invertebrates. The modeler made wax and plaster casts of all the species of fishes obtained. Contents of the dredge: Fishes — 5 *Malthopsis*, 1 *Venefica*, 1 *Halosaurus*, 1 *Porogadus*, 1 *Raia badia*, 3 *Macrurus*. Invertebrates — 26 hermit crabs, 12 holothurians, 14 red crustaceans, 2 *Polycheles*, 3 *Pennatula*, 3 medusæ, 1 squid, 1 salpa, 1 starfish (*Pseudarchaster pectinifer*), 4 worms, a few small mollusca.

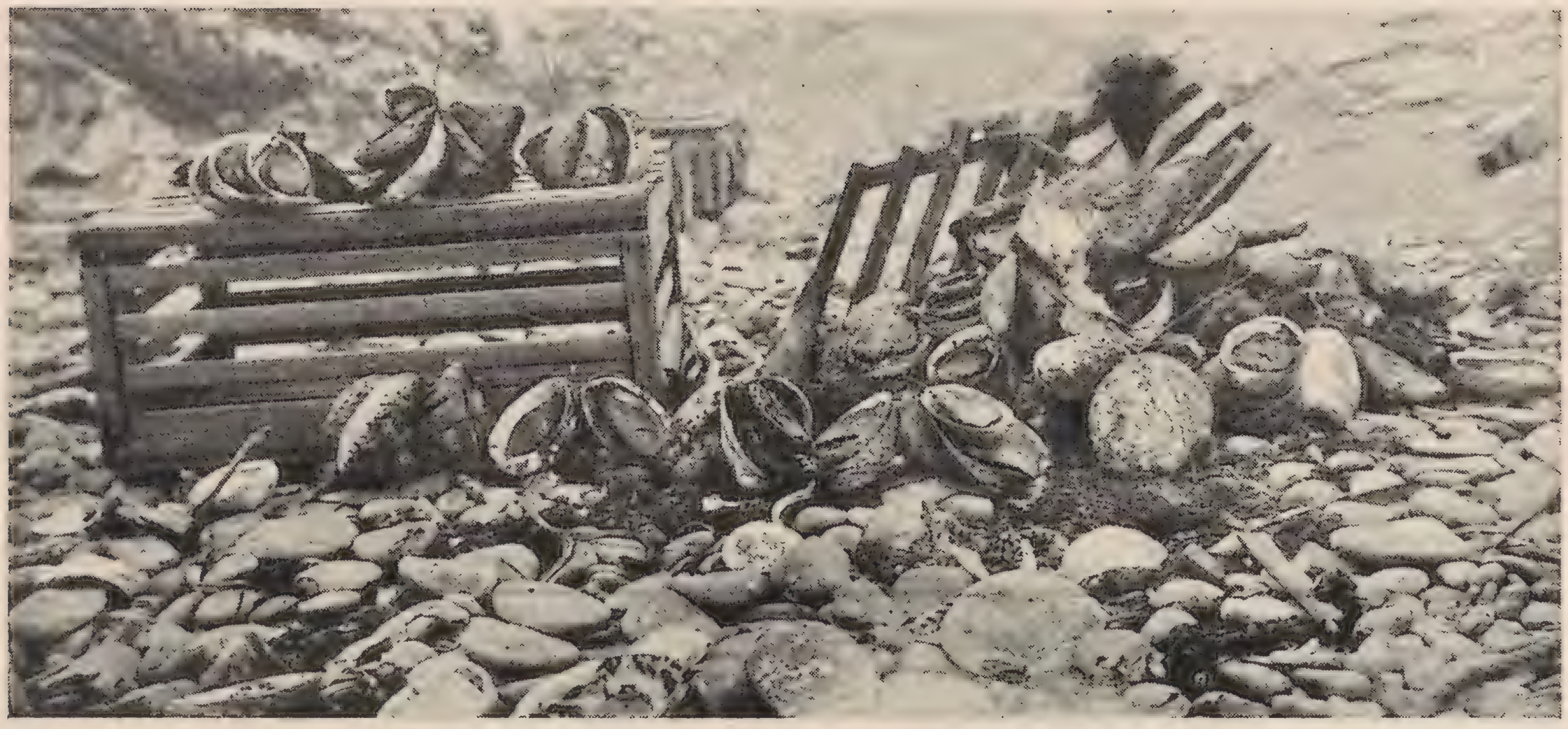

Fig. 13. 'Abalone' (*Haliotis*) used as bait for lobster pots. Meat left attached to shell and suspended inside the pot. San Bartolome Bay.

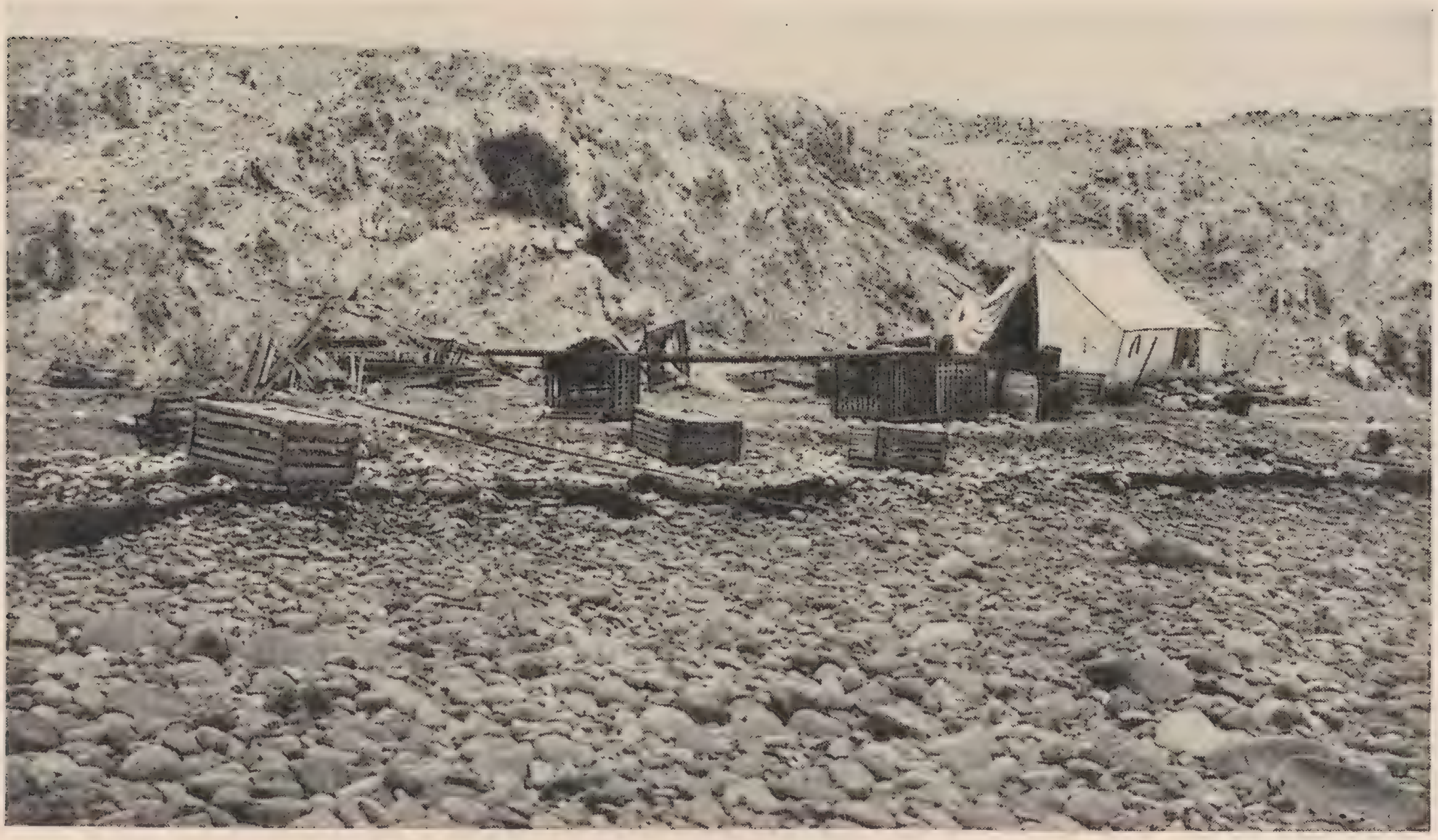

Fig. 14. Camp of lobster fishermen, San Bartolome Bay.

We dredged again at one o'clock in 735 fathoms (Sta. 5677). The catch was roughly identified as follows: Fishes — 1 *Venefica tentaculata,* 1 *Scopelengys,* 1 *Melamphœs,* 2 other small species. Invertebrates — 2 large red *Lithodes* crabs, 1 *Polycheles,* 1 *Galacantha,* 1 *Glyphocrangon,* 2 crimson prawns, 17 small brown anemones, 1 large annelid, 2 red ophiurans, 1 *Venus,* 1 *Dentalium,* 3 purple holothurians, various small mollusca.

The large *Lithodes* crabs came up *alive,* an interesting fact considering the great depth.

Santa Maria Bay was reached on the morning of the 18th where we saw a remarkable flock of about a thousand cormorants flying in a compact mass near the anchorage. Porpoises were observed in the lagoon. Here the botanist found much that was interesting; among the plants was a new species of evening primrose which he has named after Captain Burrage, and a new century plant (*Agave connochætodon*). Among the birds obtained were mangrove warbler, yellowthroat, lutescent warbler, large-billed sparrow, Xantus jay, hummingbird, sparrow hawk, raven, Audubon's warbler, bittern and green heron. The boat dredge and seine were in operation most of the day. Among the food fishes were weak-fish, king-fish, and smelts. Lizards and shore invertebrates were also collected.

We proceeded to Magdalena Bay in the evening, arriving at ten P. M. On the morning of the 19th after calling on the collector of the port, the ship was moved to Margarita Island at the southwest part of the Bay, anchoring on the northeast side above Marcy Channel. Traps were set overnight in which several woodrats (*Neotoma intermedia pretiosa*) and mice (*Peromyscus eremicus polypolius*) were taken. This locality contained many nests of the woodrat, most of which were quite bulky and covered with the dried dung of cattle and donkeys, dried cactus and small stones. An eagle's nest was found in a large elephant tree overhanging a ravine; the old birds were present but the nest contained no eggs. A good collection of plants, birds and lizards was made. While crossing the Bay a fine yellowtail (*Seriola dorsalis*), weighing fifteen and one half pounds was obtained by trolling.

On the morning of the 20th the ship was moved to Marcy Channel, between Margarita and Mangrove islands. The collecting on Mangrove Island was good and numerous birds were secured. The seine took half a barrel of mullet in the lagoon, and numerous kingfish, smelts and flounders on the beach outside. A black-tailed jack rabbit was obtained on Margarita Island. The vessel returned to the village anchorage on the morning of the 21st, dredging on the way near the harbor entrance in thirteen and one half fathoms. All the specimens taken were shoal water forms. Seining in the lagoon near this anchorage yielded an abundance of mullet and California weakfish (*Cynoscion*). At Magdalena Bay the collectors obtained a good variety of desert birds, including plumbeous gnatcatcher, Baird's verdin, Grinnell's water thrush, black-chinned sparrow, finch, rock wren and caracara vulture. Other species of land and water forms were obtained. The vegetation about Magdalena Bay was especially dry and scorched; we were told that not a drop of rain had fallen in three years. Water holes are few and far apart in this region.

Proceeding to sea in the evening, the dredge was cast at nine the following morning in 325 fathoms (Sta. 5679) at eleven o'clock in 389 fathoms (Sta. 5680), and in the afternoon in 405 fathoms (Sta. 5681). The total catch from these three hauls was very small, being as follows: Fishes — 34 *Monomitopus,* 13 small sharks. Invertebrates — a few small crabs, prawns and shells.

Cape St. Lucas was reached on the morning of the 23d, where we remained two days. Here we found a change in the character of the desert and decidedly for the better. The bushes were higher, some of them in bloom. There were many small trees and an abundance of giant cactus. Birds were numerous and of many species and we collected for the first time forms peculiar to the Cape Region. A most important collection was made of small mammals, birds, lizards and plants. Among the mammals were: *Lepus californicus xanti, Perognathus spinatus peninsulæ, P. siccus, Neotoma intermedia arenacea, Peromyscus eremicus eva* and *Ammospermophilus leucurus peninsulæ.*

This is a most interesting region to the naturalist. Our lists of the various land forms expanded immediately into several times what we had previously secured. Considerable work was done with the seine and boat-dredge. At all anchorages up to the present time more or less collecting of small pelagic forms was done with the electric light on the surface of the water. On the 24th, while the collectors were ashore, the 'Albatross' went out and made a dredge haul just south of the Cape, in 491 fathoms (Sta. 5682). The contents of the dredge were as follows: Fishes — 29 *Macrurus,* 14 *Merlucius,* 1 *Alepocephalus,* 1 *Argyropelecus.* Invertebrates — 1 *Polycheles,* 30 *Glyphocrangon,* 5 *Heterocarpus,* 36 *Peneus,* 12 *Acanthophyra,* 6 schizopods, 20 *Munidopsis,* 2 quarts of small munida, 4 *Plumularia,* 6 anemones, 6 ophiurans, 2 starfishes (*Ceramaster patagonicus* and *Henricia clarki*), 2 echini (*Brissopsis columbaris*) and 2 ascidians. The botanist obtained over 100 species of plants at Cape St. Lucas.

The ship returned to her anchorage at noon and on the 25th proceeded to San José del Cabo. Captain Burrage and I called on the officials, saddle horses having been sent to the beach and placed at our disposal. The town is situated near the mouth of San José River, and as irrigation is practised this part of the valley is under cultivation. The mammals, birds, plants and reptiles obtained here included most of those found at Cape St. Lucas, but the variety was greater. An important collection was made of both land and sea forms; the botanist obtaining over forty species of plants. Several species of ducks were found along the shallow river.

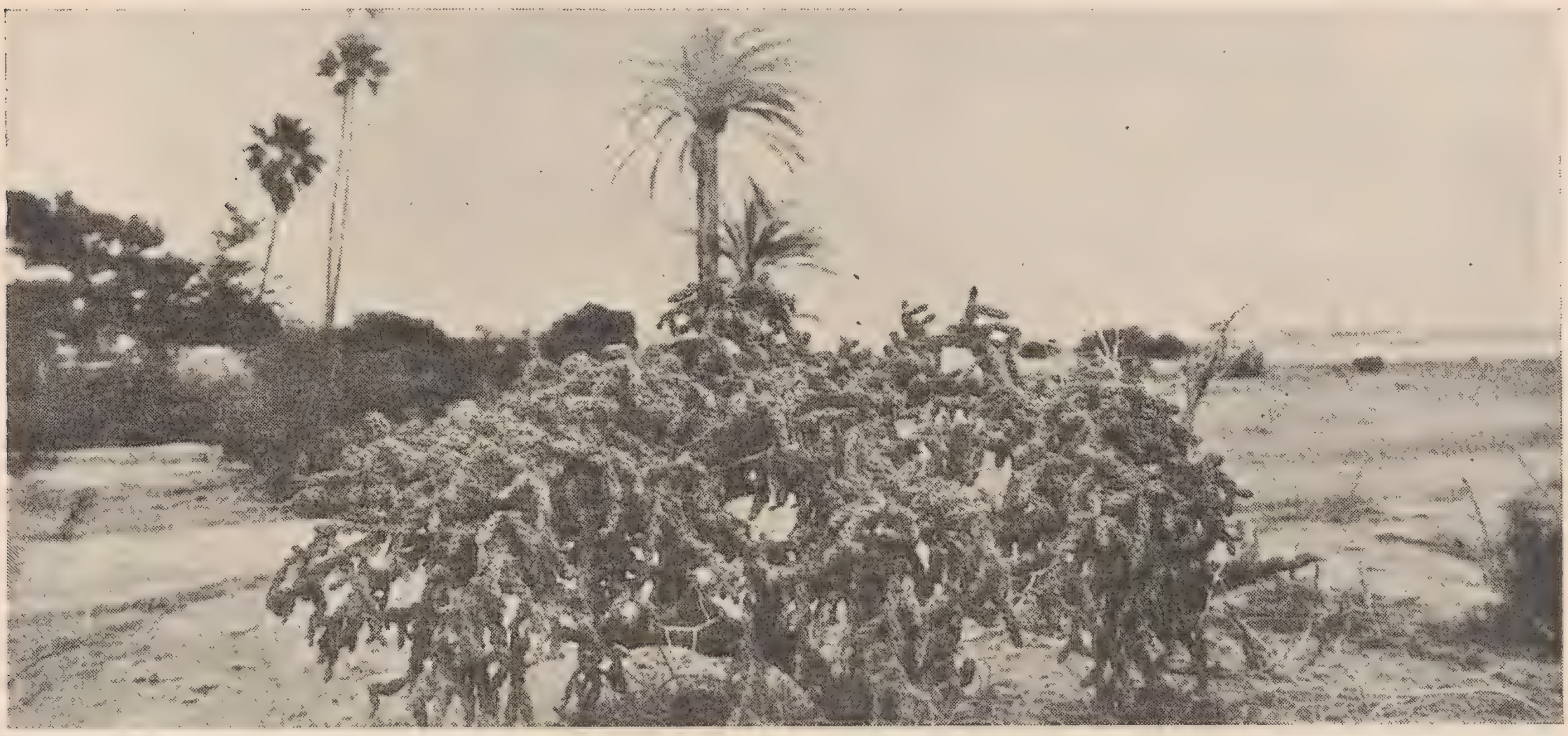

Fig. 15. "Cholla" cactus (*Opuntia*). Cape St. Lucas. One of the most troublesome of the cacti. The minute spines break off at the lightest touch and are difficult to extract from the skin.

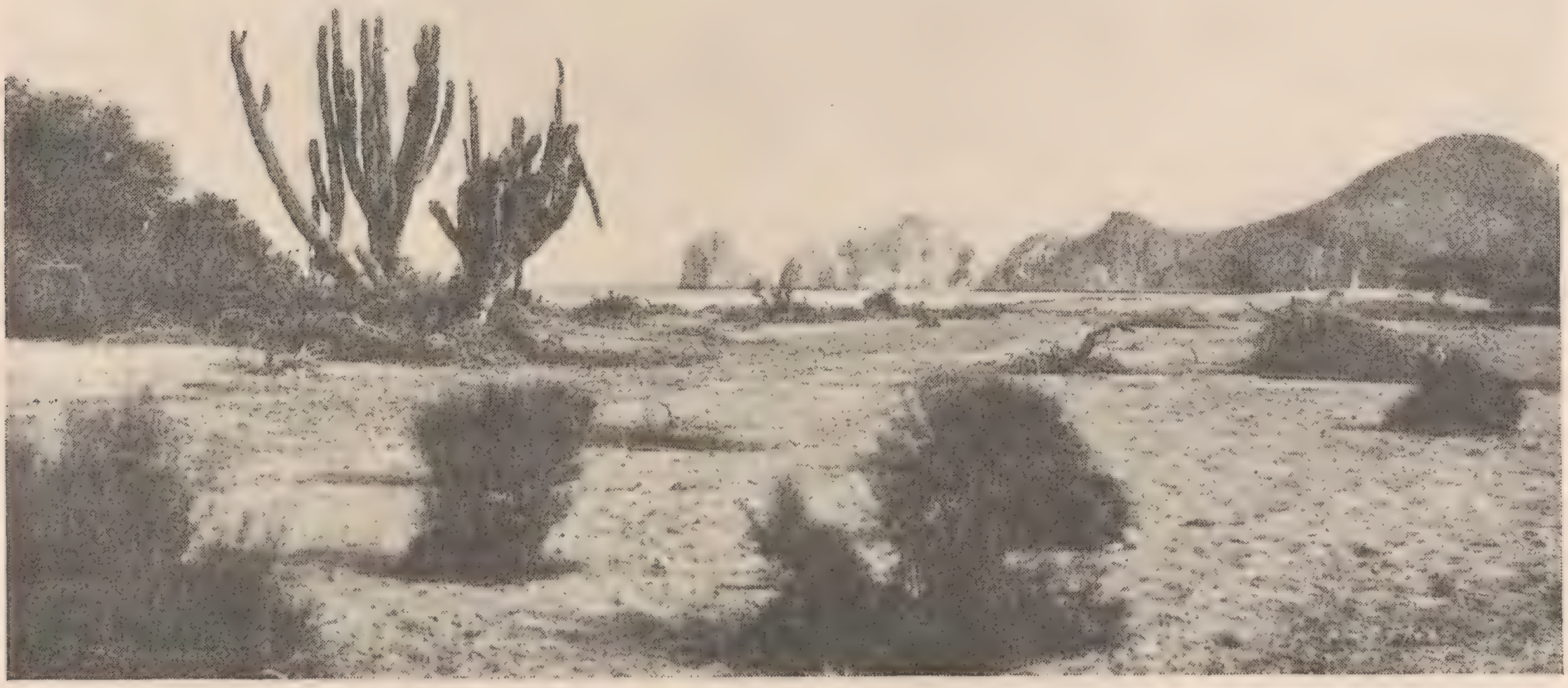

Fig. 16. Cape St. Lucas, Lower California. "Cardon" cactus (*Pachycereus*) at left.

Leaving on the evening of the 26th, the 'Albatross' arrived at La Paz (Pichilinque Harbor) on the 27th. I accompanied the officers on a visit to the American Consul and local officials, the call being returned the following day. Here as at all our anchorages, our party made a good collection of

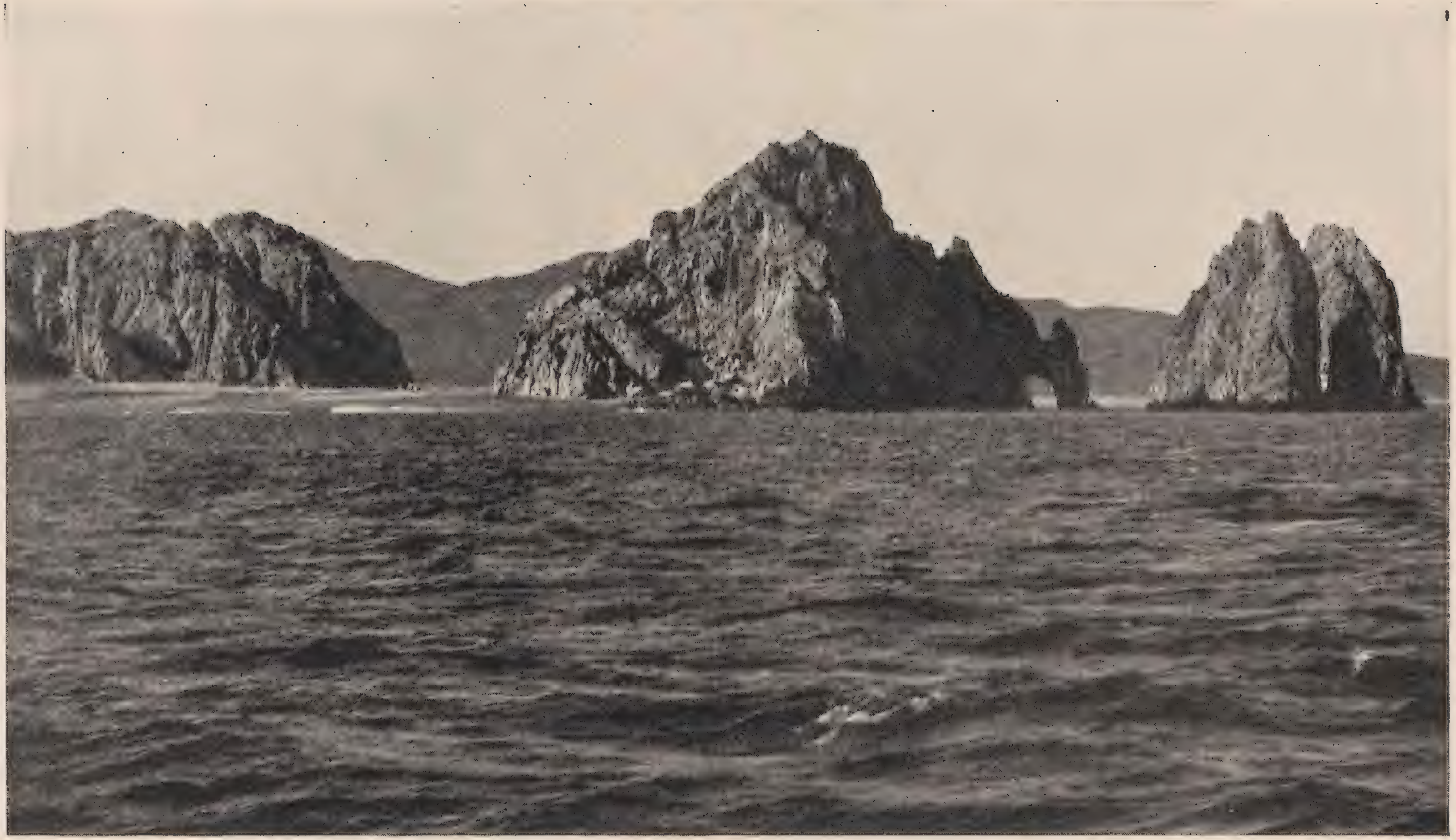

Fig. 17. Cape St. Lucas, Lower California. These outlying rocks are opposite the extreme southern end of the Peninsula.

natural history specimens, obtaining some forms not previously secured. The collection included mammals, birds, reptiles, fishes, invertebrates and plants. Among the mammals were *Lepus californicus xanti, Perognathus spinatus peninsulæ, P. rhydinorhis,* and *Peromyscus eremicus eva.*

A supply of coal being taken on board, we sailed on the morning of the 30th, arriving at San Josef Island (Amortajada Bay), and this locality proved to be an interesting one. The variety of fishes obtained was large including numerous groupers and other food species. Various shore forms of vertebrates were collected in abundance including three species of small mammals peculiar to this island. The boat dredge was used to good advantage. The ship's dredge was not in use while we remained in the Gulf, previous experience showing that such dredging was unsatisfactory. The bottom is generally covered with offensive mud and animal forms are neither numerous nor varied.

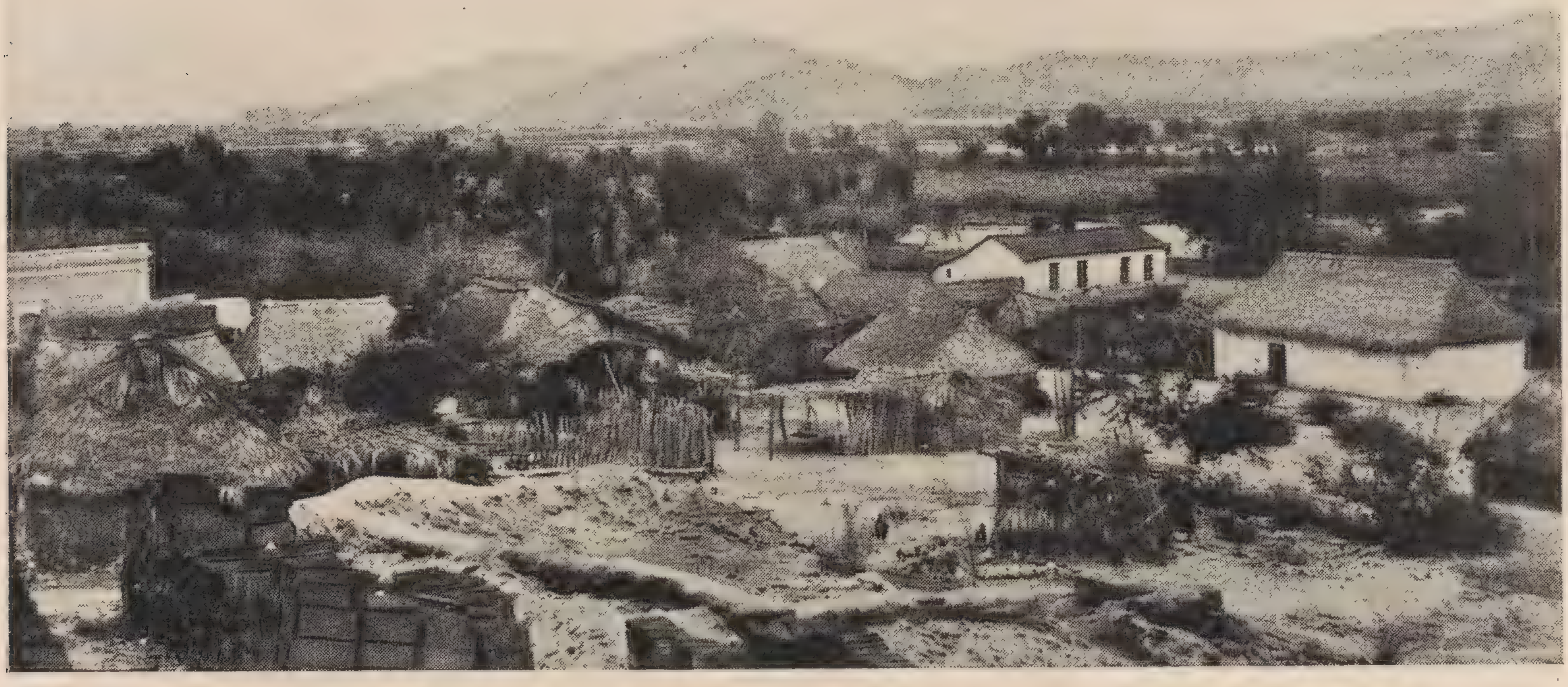

Fig. 18. Edge of the town of San Jose del Cabo, Lower California.

San Josef is 16½ miles long and from 2 to 6 miles wide, with a height of 2,077 feet.

On the morning of April 1, we left for Agua Verde Bay where we arrived at 3 P. M. This is an attractive little harbor with a fine beach and there are a couple of small ranches in the neighborhood. As at the localities previously visited, the principal catches in the small traps were wood rats and wild mice. Among the fishes taken at Agua Verde were several specimens of the barracuda (*Sphyræna argentea*).

We found the natives preparing tan-bark for shipment to La Paz. This appears to be the basis of an industry carried on in Lower California where-

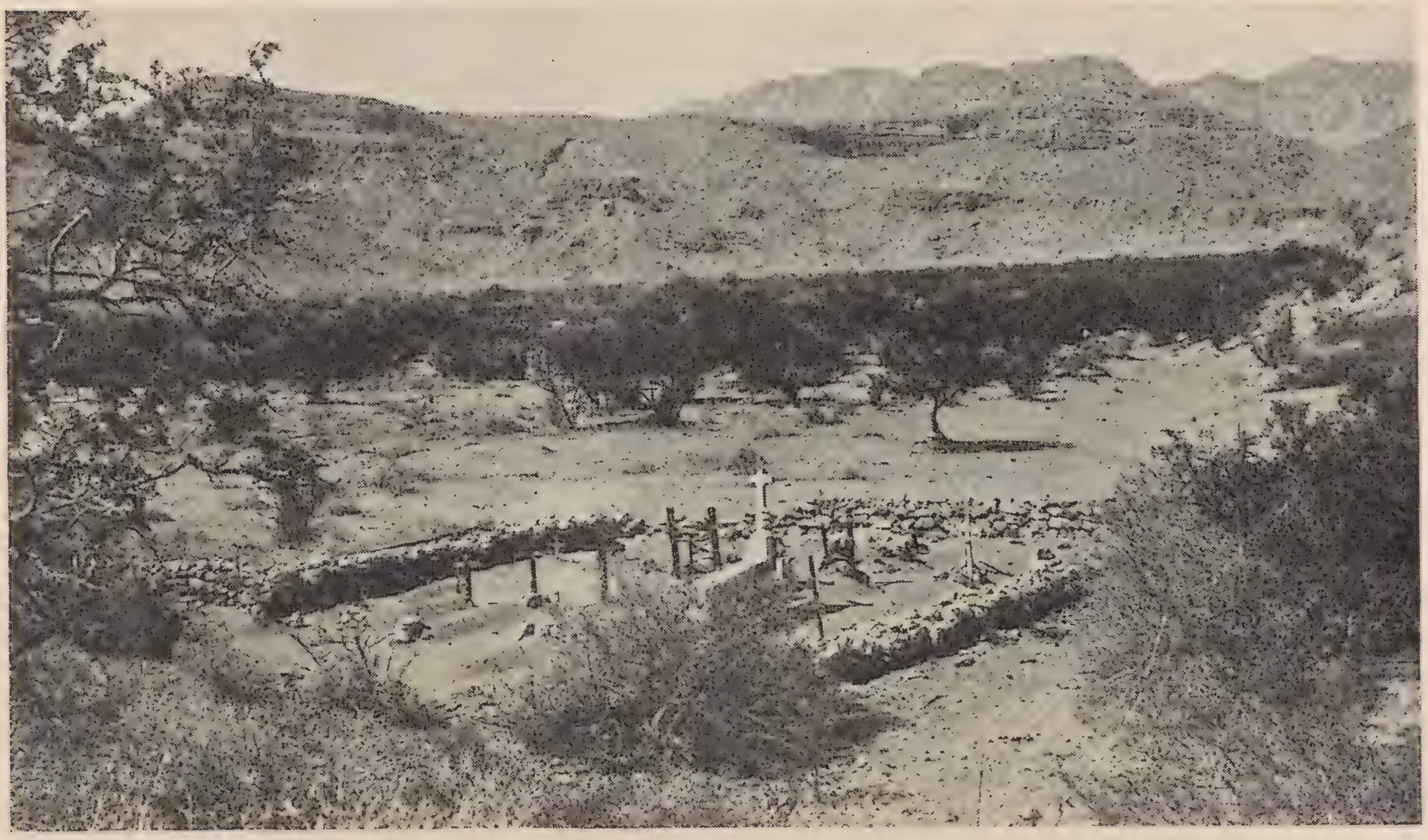

Fig. 19. View at Agua Verde Bay, Lower California.

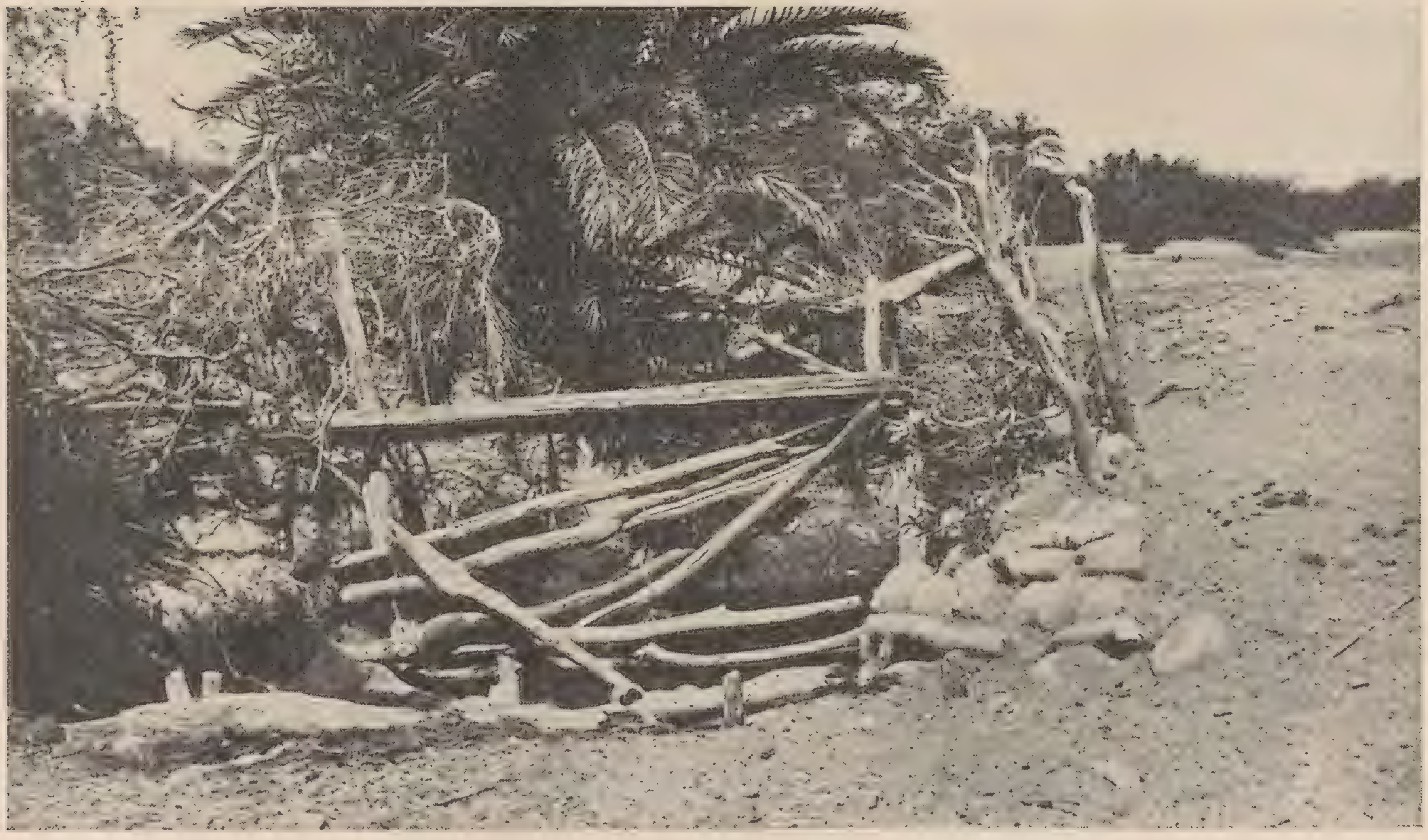

Fig. 20. A fenced-in water hole. Agua Verde Bay, Gulf of California.

ever the Palo Blanco tree is abundant. The bark is light and is packed in sacks. The botanist obtained eight species of cacti.

The duration of the cruise being limited to two months, our reconnaissance of the coastal region of the Peninsula was necessarily carried on rapidly. We attempted, however, to make the most of our stops, and the collection of the fauna and flora grew steadily.

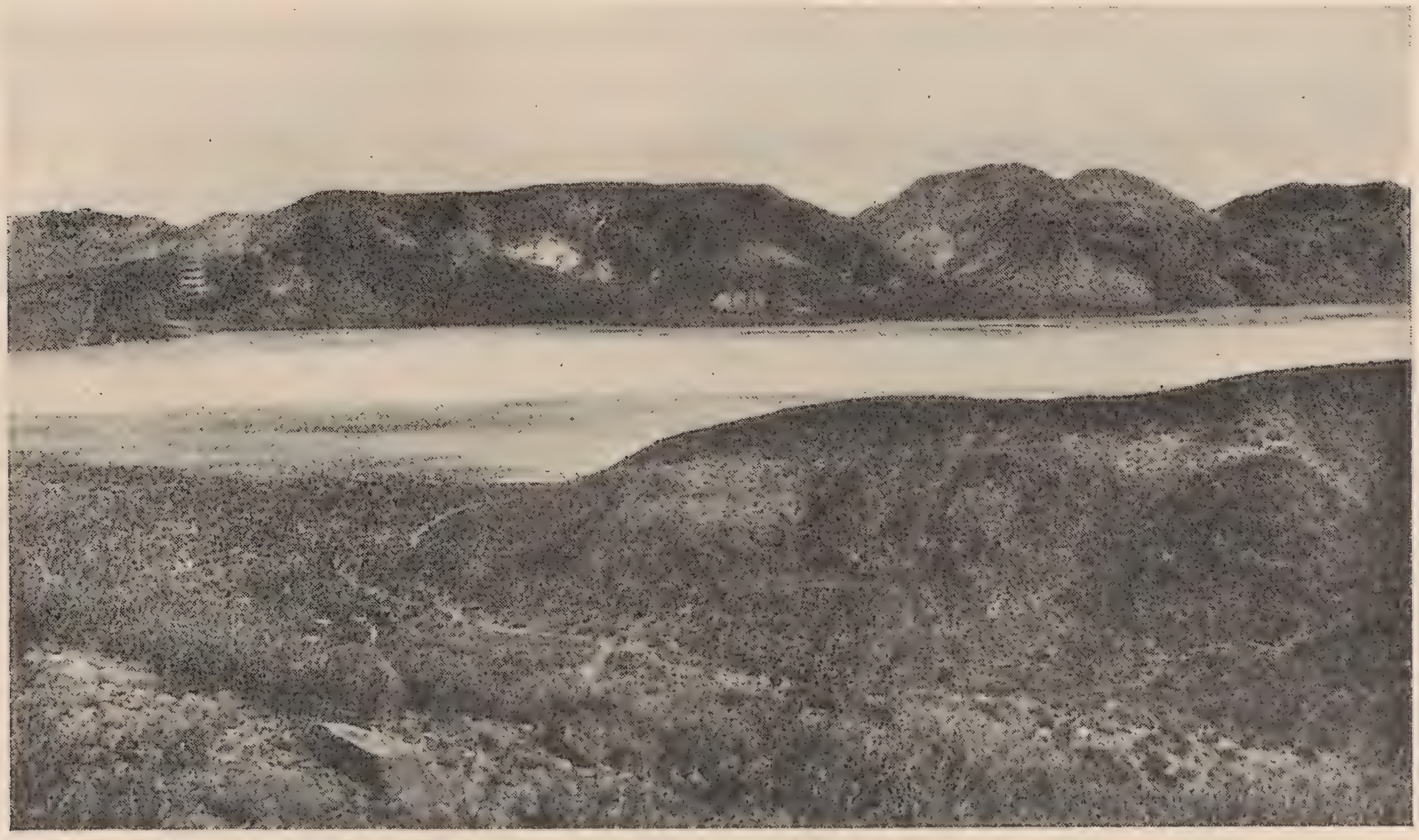

Fig. 21. Salt Lake at Carmen Island. View of the central portion.

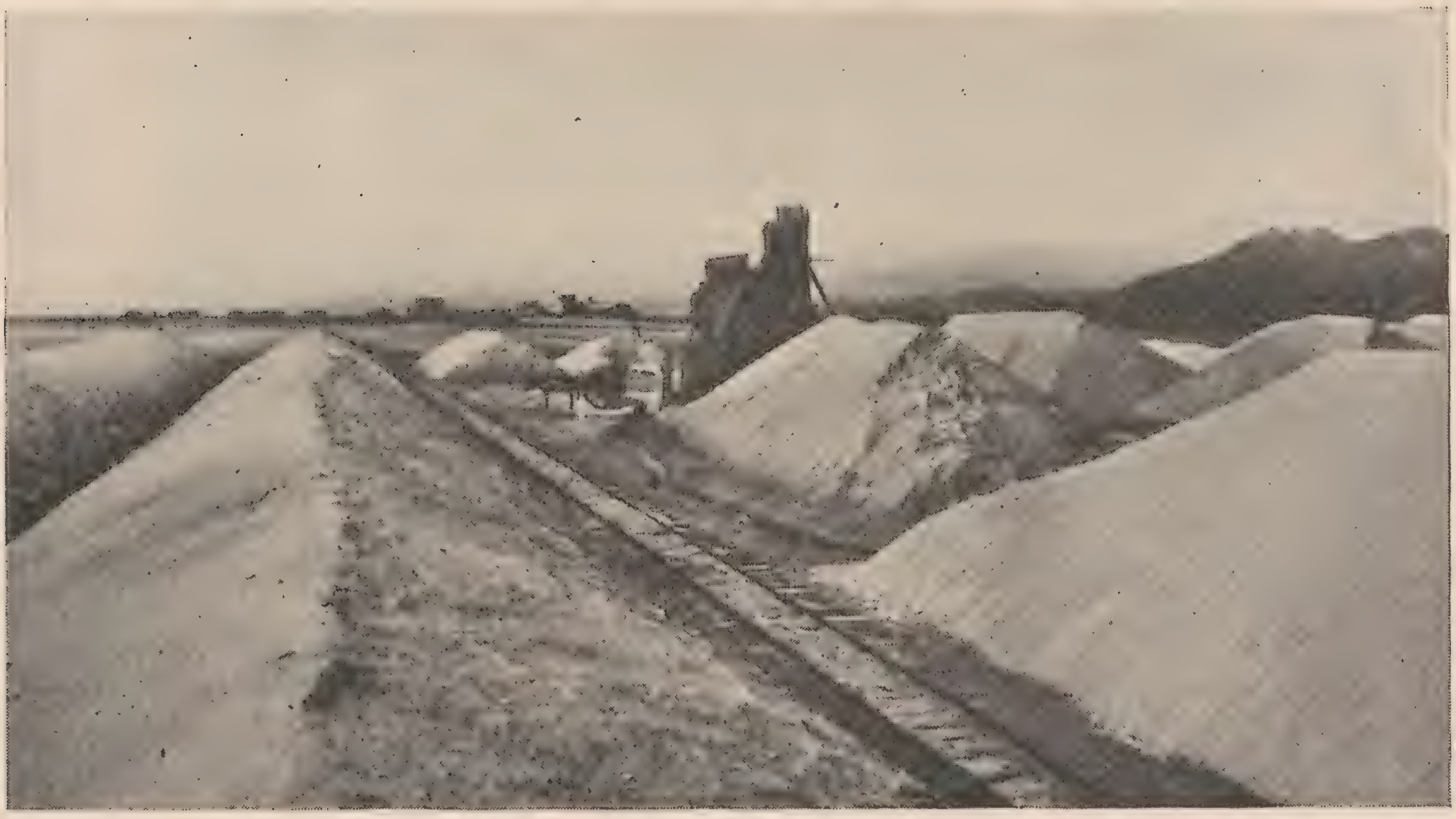

Fig. 22. Salt heaps at Carmen Island. Showing salt as dug from surface of lake.

Leaving Agua Verde on April 2 at 11:30, we reached Carmen Island, celebrated for its salt deposits, at 3:30, anchoring off the salt works. Here, as at other islands visited, the party made the most of the time afforded. The fishing operations yielded many food and other fishes. For the benefit of the botanist, the manager of the salt works provided horses for a ride to Ballandra Bay on the west side of the Island. Passing down a valley leading to this bay we found the vegetation much more luxuriant than we had encountered elsewhere. Dr. Rose found a new century plant (*Agave carminis*) and collected ten species of cactuses, including the great barrel cactus (*Echinocactus diguetii*). The seining yielded an important collection of food fishes of several species, among them being "cabrilla piritita" (*Mycteroperca pardalis*) and "mojarra dorada" (*Gnathanodon speciosus*). Among the mammals obtained were two new species of mice (*Perognathus spinatus occultus*) and (*Peromyscus eremicus carmeni*). The salt deposit of Carmen Island is a notable one. It is in reality, a lake of snow-white salt nearly two miles long and a mile wide. The surface salt is dissolved during the annual rainy season and after re-crystallizing forms new supplies. The deposit appears to be inexhaustible and only about one-tenth of the lake

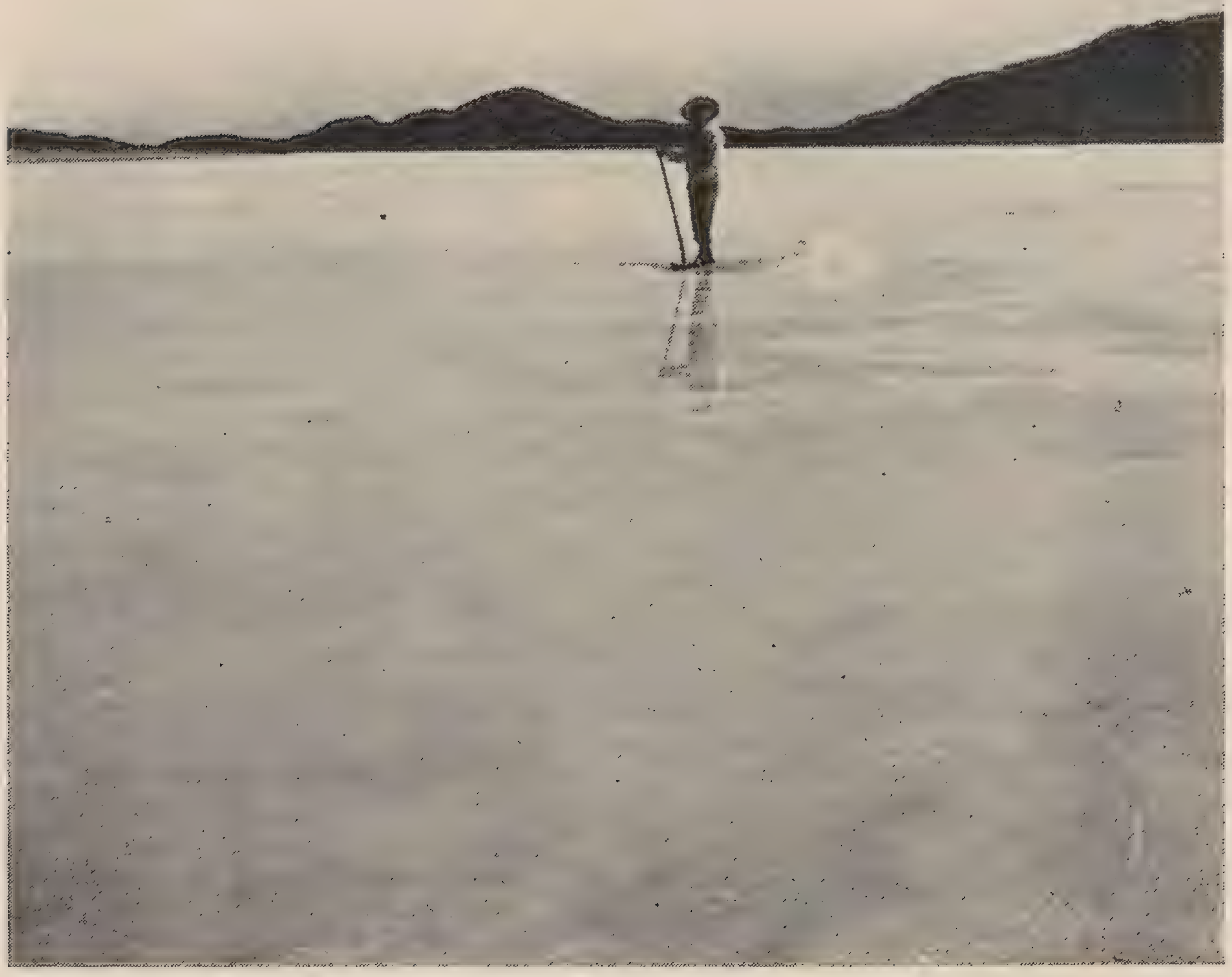

Fig. 23. Salt Lake at Carmen Island. Salt digger at work.

surface has ever been worked. There were about sixty tons of salt piled up ready for use. The crystallization is heaviest after the rains. Later on the salt is taken from the few moist localities where a little water remains. These can be emptied by the cart-load daily, about twenty-four hours being sufficient for a new supply to form in the same spots. As much as 35,000 tons have been shipped in one year, but much more could be supplied if demanded. Its purity is such that it requires no refinement. This salt deposit has been worked commercially for about fifty years and is at present in the hands of an English company. The salt lake has no connection with the sea. The deposit of salt is known to be at least 15 feet in depth.

Carmen Island is 17 miles long by 5½ miles wide and has a height of 1500 feet.

Leaving Carmen Island on the evening of the 3d, we anchored at Mulege on the Peninsula, on the morning of the 4th. Some of the officials visited the ship in the morning, the Captain returning the call later in the forenoon In the afternoon many of the citizens came to the ship and in the evening the officers were entertained ashore. The collectors were busy as usual, and obtained good results. Among the food fishes taken at Mulege was the large and important crevallé (*Caranx hippos*) which is found also on the Atlantic coast, numerous weakfish, kingfish and red snappers.

On the morning of the 5th, the ship proceeded to the head of Concepcion Bay, about thirty miles inland from Mulege, where our work was carried on with gratifying success. Mountain sheep occurring in this region, I made a hunt for them, but only one was seen and this one not secured. Four pairs of horns were obtained from Señor Castro, a ranchman in the neighborhood. The mountain sheep occurs on both sides of this bay but is more common among the higher ranges farther inland.

Dr. Bartsch made an important collection of marine invertebrates in this locality, both along the shore and by means of the boat dredge. Here, as at all localities visited on the Peninsula from Cape St. Lucas northward, we found quail and doves in abundance. The shore collections in general were important, but the character of the beaches did not permit of seining. A number of grunts, groupers and red snappers were taken by other means. We saw uncommonly large schools of porpoises moving about the Bay, one of them containing perhaps two hundred individuals. The ranchers here had a few cattle and donkeys, and occasionally collected iron-wood (palo ferro) for sale at Guaymas. The botanist secured among other things a new species of century plant (*Agave affinis*).

The ship was moved six miles northward to Ricason Island on the morning of the 7th, where we engaged in profitable work until the following day at 1:30, when we returned to Mulege. After a stop of three hours, we proceeded northward to San Francisquito Bay, arriving at 2 P. M. This proved to be one of the best localities visited during the cruise for marine invertebrates, and a great variety of such forms was obtained. A considerable number of fishes was secured. At nearly all localities we obtained an abundance of food fish for the crew.

On the morning of the 10th the 'Albatross' went to Angel Guardia Island, arriving at noon. This large island is said to be entirely lacking in fresh water and, like nearly all other islands in the Gulf, is uninhabited. The land forms were especially interesting; among the birds taken were burrowing owl and great-horned owl. We obtained eighteen specimens of the large black lizard (*Sauromalus hispidus*) and found rattlesnakes (*Crotalus atrox*) abundant. Four of the black lizards exceeded two feet in length. The beaches were unsuitable for successful work with the seine, but a number of fishes were obtained by other means, one of them being *Mycteroperca venadorum*, an important food fish which reaches a weight of 150 pounds. About 60 of these were taken, averaging 15 pounds each. Four large California jewfish were caught, the largest weighing 70 pounds. Among the mammals procured here were a new woodrat (*Neotoma insularis*), and a new mouse (*Peromyscus guardia*). Angel de la Guardia, near the western shore of the gulf, is 40 miles long by about 10 miles wide and has a height of about 4000 feet.

On the morning of the 11th, we proceeded to the south end of Tiburon Island, arriving at 3 P. M. The general appearance of this island is not different from that of other islands in the gulf, except in its greater height, all the islands being essentially desert-like in character and most of them entirely without fresh water. Tiburon is uninhabited by whites but there are Seri Indians on the north and east sides. We saw nothing of the latter and no signs of human occupation except a deserted camp of turtle hunters on the beach. Lieutenant Stanley killed a buck weighing 121 pounds, not including the viscera, while I killed a doe which was considerably smaller. The small traps yielded several kangaroo rats. The burrows of these animals were to be seen everywhere in the level places, and were mostly connected by well-beaten trails.

Five new species of mammals were obtained: a coyote (*Canis jamesi*),[1] a jack-rabbit (*Lepus alleni tiburonensis*), a wood-rat (*Neotoma albigula seri*), and two pocket mice (*Perognathus penicillatus seri* and *Perognathus baileyi insularis*). The mammals, birds, lizards and plants obtained here were all valuable, as very little is known of the fauna and flora of this island. One land tortoise was procured and the botanist found a new century plant (*Agave subsimplex*). Our explorations extended about five miles inland in several directions, but we found no evidences of fresh water. The seine, fishing lines, and boat dredge were all employed successfully. The food fishes taken included large jewfish, grouper and mullet.

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[1] Named for Mr. Arthur Curtiss James of New York.

Tiburon is the largest island in the Gulf. It is 30 miles long by about 15 in width and has a height of 4000 feet. It is separated from the Mexican mainland by a channel from one to three miles wide. The Seri Indian inhabitants are reported by the Mexican authorities to be dangerous to small parties.

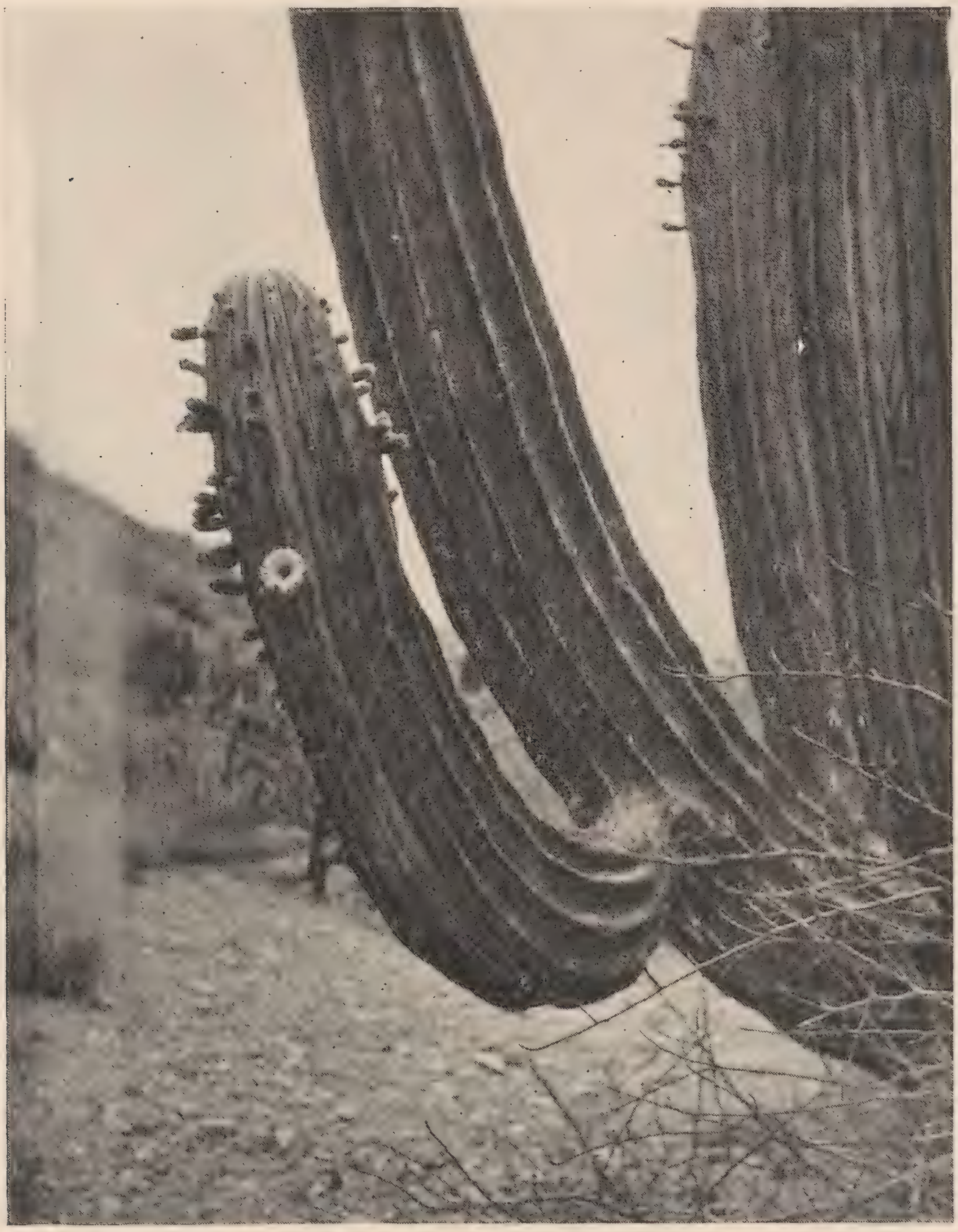


Fig. 24. Giant cactus (*Pachycereus*) in bloom. Santa Catalina Island, Gulf of California. April 16, 1911.

The 'Albatross' left Tiburon Island at 11 o'clock on the morning of April 13, arriving at San Esteban Island at 1:30. Almost upon landing we began to obtain specimens of two species of large lizards, one a *Sauromalus*, the other apparently *Ctenosaura hemilopha*. They occurred in shallow depressions under large stones and were usually detected by their tails, which were not always drawn in out of sight. They were captured easily by turning the stones, which were not generally too large for a couple of men to handle. Forty-seven specimens in all were captured alive, the largest being thirty inches long. The *Sauromalus* proved to be new to science. Two rattlesnakes (*Crotalus molossus*) were also secured and a few mice and birds, while the botanist obtained a new century plant (*Agave dentiens*). A new species of mouse obtained here has been named *Peromyscus stephani*. San Esteban is about 4 miles in diameter, exceedingly rough and mountainous, with a height of 1800 feet. It lies 8 miles S. W. of Tiburon, is without fresh water and is uninhabited.

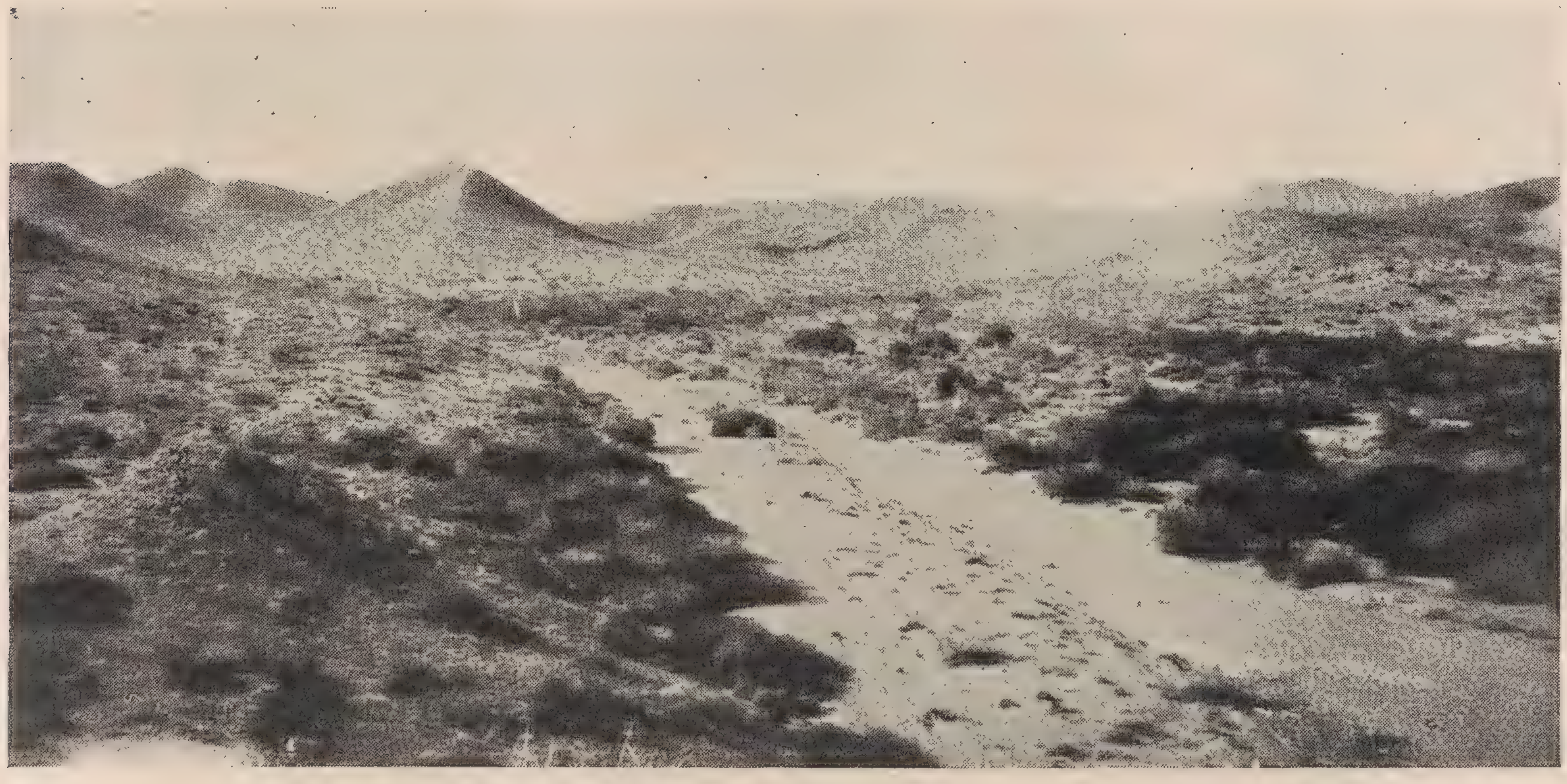


Fig. 25. Valley at south end of Tiburon Island, Gulf of California.

The flow of the tides is very strong in this part of the Gulf. During the night the ship dragged anchor somewhat on the ebb tide. When we left for Guaymas at 8:30, the anchor came up minus a fluke which had broken off. The tide was running fiercely, and with half a gale of wind also in our favor, we started for Guaymas under sail and steam. Passing San Pedro Martir Island at noon, where it was impossible to make a landing on account of the weather, we reached Guaymas after dark.

On the following morning the Captain and I called on the American Consul and some of the local officials. Dr. Bartsch left the ship at this point on his way to Panama, but finding no satisfactory transportation proceeded to Washington by rail. Two crates of live reptiles, large lizards

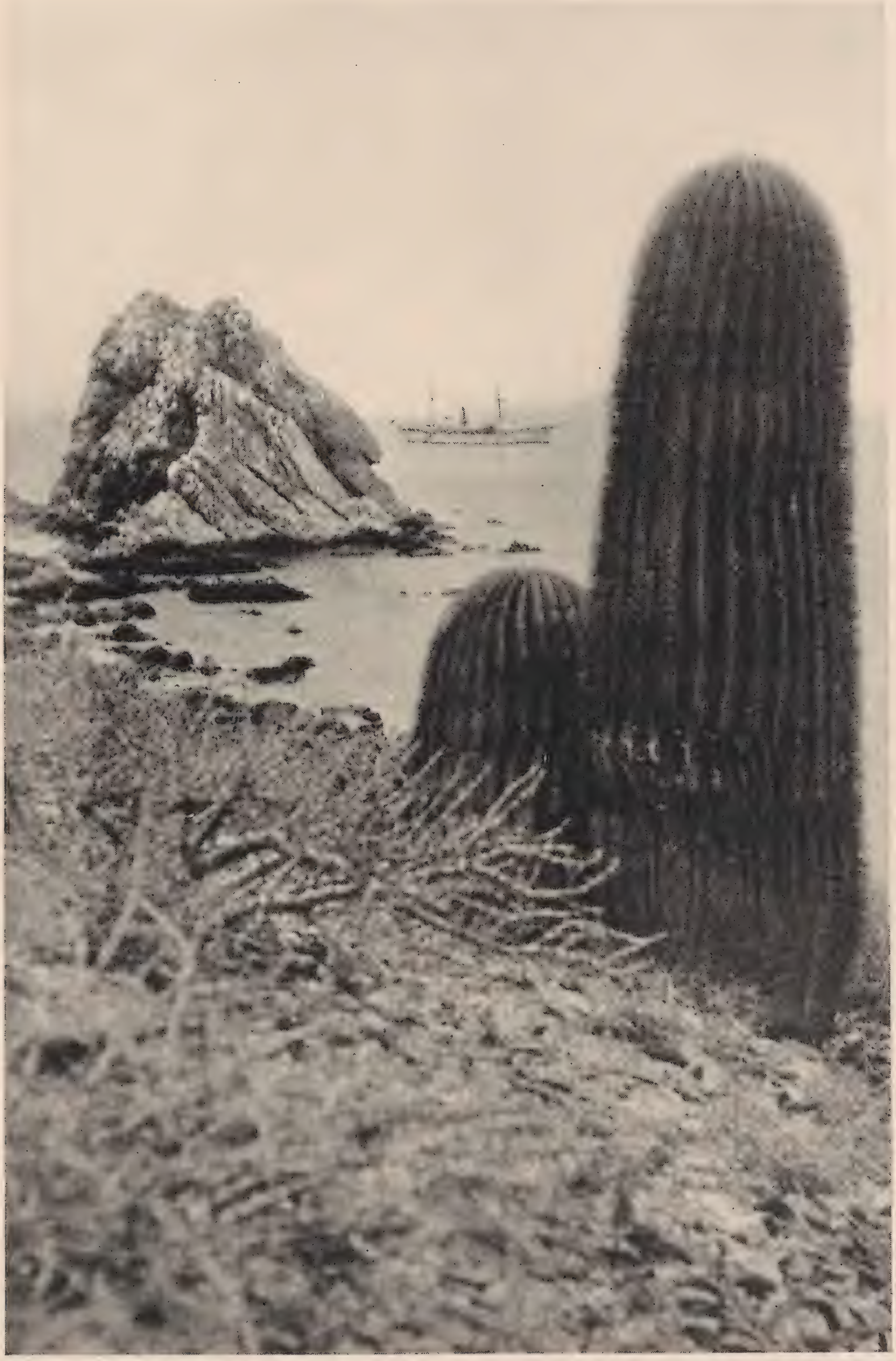


Fig. 26. The 'Albatross' at Santa Catalina Island, Gulf of California. "Viznaga" cactus (*Echinocactus diguetii*) 12 feet high.

and rattlesnakes were forwarded by express to the Zoölogical Park at New York.

We left Guaymas at 6 P. M., and reached Santa Catalina Island, near the west side of the Gulf, at 9 o'clock of the 16th. The botanist found this a rich locality, there being many large barrel cacti (*Echinocactus diguetii*) some of them 15 feet high. One of the largest measured seven feet in circumference. A number of skulls of porpoises (*Globiocephalus scammoni*) and one of *Tursiops nuuanu*, a new species, were obtained on the beach where fishermen had evidently been making porpoise oil. A good collection of fishes and lizards was obtained. The fishes included a sea bass (*Dermatolepis punctatus*) 30 inches long and some groupers.

We left at noon for Santa Cruz Island a little farther south, arriving at 3 o'clock. Here additional skulls of porpoises were obtained on the beach and a good collection was made of fishes and shore forms.

Leaving Santa Cruz at 5 P. M., we reached La Paz (Pichilinque Bay), on the morning of the 17th where the usual work of the expedition was resumed. The following day the collecting party, including the botanist, was sent by launch to Espiritu Santo Island with a tent to remain over night and be picked up by the ship the next day on her way south. While the ship was coaling, we again called on the officials, procured our mail and made inquiries respecting the fisheries.

On the morning of the 19th, the 'Albatross' reached Espiritu Santo, arriving at 9 o'clock. The collectors came on board with one specimen of the interesting black jack rabbit (*Lepus insularis*) peculiar to this locality, an introduced specimen having been previously secured on Pichilinque Island. They obtained also wood-rats, mice, lizards, birds and plants. Among the last was a new century plant (*Agave roseana*). We remained here until noon, visiting the pearl shell propagating station, under the guidance of the manager, Mr. Gaston Vives. Some excellent photographs of this important station were secured. An account of the pearl fishery will be found under another heading.

Leaving at noon, we reached Ceralbo Island on our way down the Gulf at 3 P. M. The most interesting find here was the large black and white lizard (*Ctenosaura hemilopha*) the species obtained on San Esteban Island farther up the Gulf. Seven specimens of this lizard were taken, four of which exceeded two feet in length. A few fishes were also secured.

Ceralbo is 15½ miles long by about 4 miles wide, with a height of 2,477 feet. It lies east of La Paz Bay and is not more than five miles from the nearest point on the Peninsula.

Leaving Ceralbo at 6 P. M. we reached San José del Cabo on the morning of the 20th. Here Mr. Osburn left the ship with a collecting outfit with instructions to hire pack animals and make a month's trip into the Sierra Laguna mountains for mammals, birds and reptiles. Governor Sanginez at La Paz had furnished him with a letter of introduction to the authorities at San José del Cabo for this purpose. He had instructions to proceed to San Diego by steamer a month later. The trip into the Sierra Lagunas yielded numerous species of mammals, birds and reptiles not obtained elsewhere by the 'Albatross' expedition.

Leaving San José del Cabo at 10 A. M., the work of dredging was taken up seriously. Off Cape St. Lucas, at 12:30, the dredge was lowered in 630 fathoms (Sta. 5683). The fishes obtained were *Macrurus, Melamphœs, Malthopsis, Serrivomer, Alepocephalus* and *Sebastolobus*. Among the crustaceans were *Gnathophausia, Glyphocrangon, Nephropsis, Galacantha, Polycheles, Munidopsis, Peneus*. Other invertebrates were sponges, holothurians, shells, worms and fragments of echini.

Proceeding northward, we dredged the following morning at 6:30 in 1760 fathoms, off Magdalena Bay (Sta. 5684). The haul was an interesting one and yielded about two quarts of black nodules resembling manganese, along with considerable animal life. It is interesting to note that the depth at this station was exactly two miles. The dredge contained the following: 1 fish (*Scopelengys*), 1 large creamy-white crustacean (*Munidopsis*), 1 very large pycnogonid, 9 sea urchins (*Cystechinus*), prawns, ophiurans, starfishes, shells, holothurians, pennatulids and worm tubes. Among the starfishes was *Eremicaster tenebrarius*, the only specimen taken during the voyage.

Continuing northward, we dredged the following morning at 8 o'clock in 645 fathoms (Sta. 5685). The catch, a most interesting one, included a specimen of *Harriotta*, the first capture of this deep-sea fish in the eastern Pacific ocean. The other fishes obtained were *Alepocephalus, Malthopsis, Melamphœs* and *Serrivomer*. The invertebrates included shells, holothurians, pycnogonids, echini and various crustacea. There were two very large bright red specimens of *Lithodes panamensis*, a starfish (*Leptychaster inermis*) and a sea urchin (*Schizaster latifrons*).

We dredged again at 3 P. M. in 930 fathoms (Sta. 5686). The only fish was an *Argyropelecus*. Among the invertebrates were starfishes (*Ctenodiscus crispatus*), ophiurans, holothurians, anemones, ascidians and crustaceans.

The following morning, April 23, at 5 o'clock, we anchored again in San Bartolome Bay. A seining party was sent to the head of the bay for a supply of fresh fish and about a barrel of edible fish, chiefly mullet, was obtained. Many spotted sharks and sting-rays were also taken and destroyed. From the lobster fishing camp we obtained several bags of fresh spiny lobsters in exchange for provisions and fresh water. The Bay was full of turtles, but the fishermen had none at hand.

The 'Albatross' proceeded to sea at 10 A. M. for San Francisco. At noon the dredge was lowered in 480 fathoms (Sta. 5687) west of Natividad Island. The fishes taken were *Melamphœs, Macrurus, Nemichthys* and *Scopelengys.* The invertebrates were ascidians, ophiurans, sponges, anemones, shrimps, annelids and a starfish (*Strongylocentrotus fragilis*).

We dredged again in 525 fathoms (Sta. 5688) at 2:30, west of Natividad Island, obtaining 20 fishes: *Alepocephalus, Macrurus* and *Melamphœs.* Invertebrates came up in abundance and variety. Among them the large red *Lithodes* crab and a starfish (*Nearchaster aciculosus*).

On the morning of the 24th the dredge was lowered in 879 fathoms (Sta. 5689) east of Guadalupe Island, bringing up *Macrurus* fishes and invertebrates of the groups already obtained, together with some sea urchins (*Urechinus reticulatus*).

The dredge was hauled again at 10 o'clock in 1101 fathoms (Sta. 5690), and brought up invertebrates only, consisting of crustaceans, shells, starfishes and holothurians. Of the starfishes there were four species: *Hymenaster quadrispinosus, Zoroaster ophiurus, Brisinga panamensis* and *Pectinaster agassizii.*

The whole catch was imbedded in about a barrel of stiff gray mud. This clay after a little working was found to be equal to modeler's clay in texture and was at once employed on board ship by our modeler for that purpose.

On the 25th, at 6 o'clock, dredging was resumed southwest of San Diego, California, in 868 fathoms (Sta. 5691). This haul was also embedded in gray mud like the modeler's clay referred to above. The contents of the dredge haul were interesting, there being among the fishes one *Cyema,* a genus not before known in the Pacific. The other fishes were *Argyropelecus* and *Melamphœs.* Among the invertebrates were a dozen fleshy starfishes (*Hymenaster perissonotus*), and some brachiopods.

At 11 o'clock on the 25th, we dredged in 1076 fathoms (Sta. 5693) west of San Nicolas Island. The haul was a large and important one, containing seven species of fishes, there being twenty large rose-red *Sebastes* and a large pink *Liparis.* Among the invertebrates was a fine *Anthomastus,* a large brachiopod and a starfish (*Psilaster pectinatus*).

The dredge was hauled again at 9 o'clock in 640 fathoms (Sta. 5694). It contained a good variety of fishes and invertebrates. There were five species of very large starfishes, and as many of small ones. Among those identified were *Thrissacanthus penicillatus, Hippasteria californica, Solaster borealis,* and *Heterozonias alternatus.*

The third haul for the day was made at 1 o'clock in 534 fathoms (Sta. 5695) and yielded a variety of fishes and invertebrates. Among the latter were crinoids, octopus, *Lithodes* and starfish (*Solaster paxillatus, Lophaster furcilliger,* and *Pteraster jordani*).

On the 27th, at 6 A. M., we dredged again in 440 fathoms (Sta. 5696) taking an abundance of fishes and invertebrates of many kinds, among them starfishes (*Peribolaster biserialis*) and sea urchins (*Schizaster townsendi*).

At 10 A. M. the dredge was lowered in 485 fathoms (Sta. 5697) bringing up two specimens of *Chauliodus* and four other species of fishes. The most interesting of the invertebrates was an octopus with webbed arms. Additional specimens were secured of *Schizaster townsendi,* a sea urchin described by Agassiz from several points between the Gulf of California and Panama out to depths of 995 fathoms.

At 2 o'clock we dredged in 475 fathoms (Sta. 5698) with satisfactory results. The fourth haul for the day, and the last dredge haul of the voyage, was made at 6 P. M. in 659 fathoms (Sta. 5699). The results were similar to those of the preceding haul.

The 'Albatross' arrived at San Francisco on the morning of April 28 and anchored off Sausalito. The ship's collection in general being a large one, several days were required for packing and a special car was secured for its transportation to the east.

Fisheries and Fishery Resources.

Pearl Fishery.— Important pearl fisheries have been conducted in the Gulf of California ever since its discovery by the Spaniards.

La Paz is the center of the pearl shell industry of Lower California, in which there are three companies engaged. The largest of these is the Mangara Exploration Company, Ltd., an English corporation which operates from the head of the Gulf of California southward to Guatemala. According to Mr. F. W. Moore, general manager, the Lower California yield of pearl shell amounts to about 60 tons a year from the Gulf alone, valued at $100. to $350. (gold) a ton, according to the grade. (The value in 1912 was much higher ranging from $200 to $500. gold). The shell is classified in three grades, the first being the most valuable. The product finds its principal market in England. The company operates with a capital of $150,000. The principal part of the catch is made in Pacific waters, where operations are carried on from November to May. In the Gulf of California the work is done chiefly from July to October. The concession of the Mangara company extends until 1932.

The Mangara Company operates 4 schooners and 21 boats: there being diving outfits with each boat. The number of men employed by this company is 150 and the annual yield of shell 175 to 200 tons. The schooners with their boats are divided into three fleets, the divers of each fleet using their schooner as the home base. Pearl fishing is carried on at depths varying from 20 to 120 feet.

A concession for pearl fishing around the islands of Espiritu Santo, San José and Ceralbo in the Gulf, and also in Charmela Bay, sixty miles north of Manzanillo in the Pacific, is held by Señor Miguel Cornego of La Paz. With him is associated Señor Gaston J. Vives, in the management of the "Compania Criadora de Concha y Perla de la Baja California," engaged in the propagation of the pearl oyster. The concession for oyster cultivation dates from 1903.

During the years 1910 and 1911 the total amount of shell exported from La Paz and derived from the waters adjacent to the Peninsula of Lower California was 331 tons. The industry has suffered considerably as a result of disturbed political conditions in Mexico.

The above figures relate to pearl shell only, and do not include the value of pearls, which is reported to amount to about $100,000 annually.

Pearl Oyster Cultivation.— An important feature of the pearl fishery of La Paz is a station for the cultivation of the pearl oyster under the management of Señor Gaston Vives. This station is located at San Gabriel Cove, Espiritu Santo Island, in the Gulf of California, fifteen miles from La Paz and is the only establishment of the kind in the world.

The station has the appearance of being well adapted for the purpose for which it was constructed. A great deal of space is occupied by the equipment of the station and there is evidence that a considerable amount of money has been carefully invested in the enterprise. The sub-station of La Gallina on the opposite side of the cove, we had no opportunity to visit.

The methods of pearl oyster culture practised here include the collecting of young spat or seed in the open bay in artificial collectors, the transferring of this seed to an artificial canal to which the tide is admitted and where they are protected from their enemies by wire-screened gates, and finally, after a period of growth and protection, a transferrence back to the natural bottom in the open bay, in protected crates until mature growth is attained.

The lagoon at San Gabriel has been cut off from the bay by a heavy barrier of masonry, behind which has been constructed a long zig-zag canal of masonry for the protection of the immature crop of shells. This, the so-called hatchery, is the place of growth for young shells obtained from the spat collectors in the bay outside. The numerous cross sections of the canal afford ample space for the operations of oyster cultivation and have a uniform depth of seven or eight feet.

The entrance is well screened to exclude mollusk-eating fishes, star-

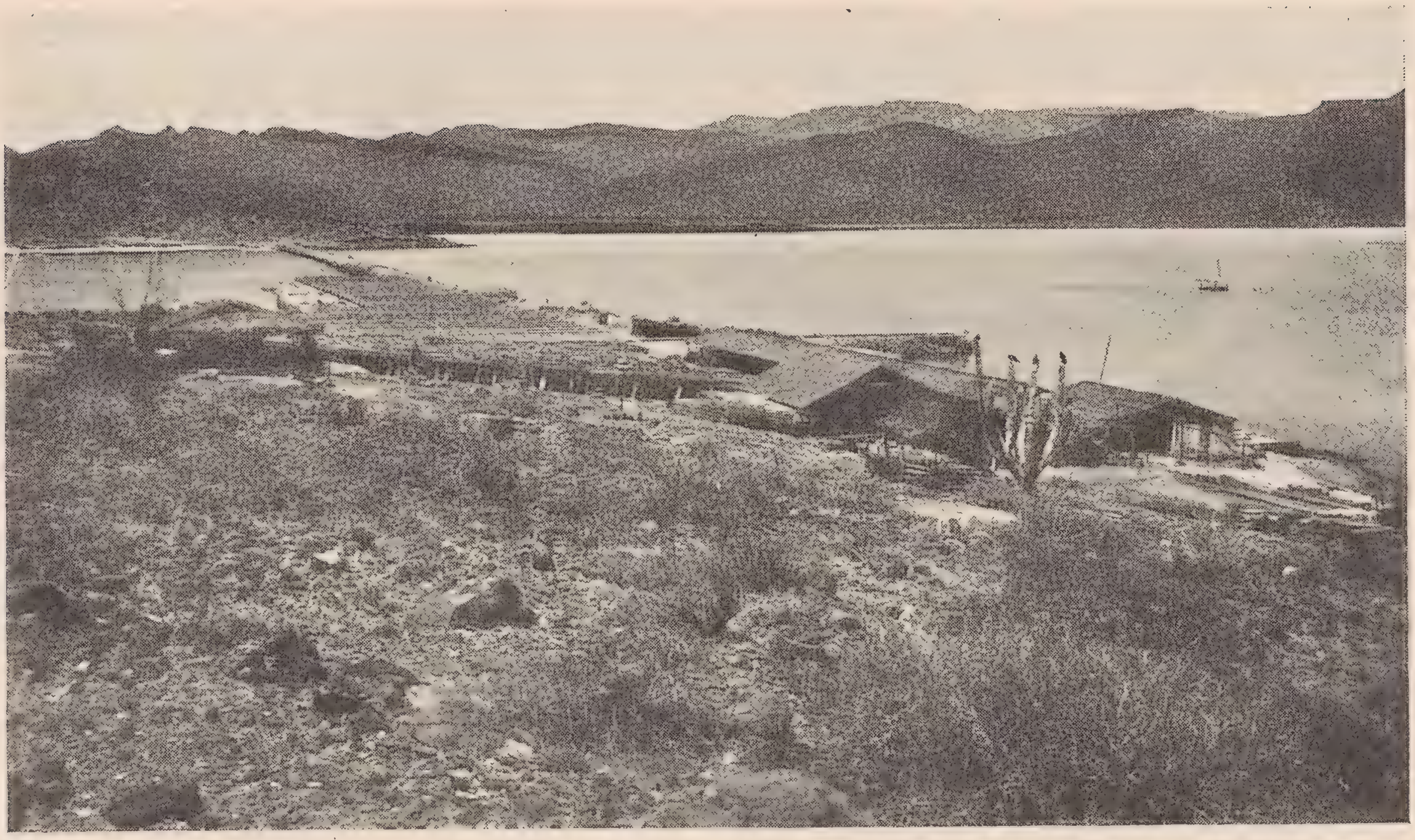


Fig. 27. General view of station for cultivation of the pearl oyster. Espiritu Santo Island, Gulf of California. (The negative was unfortunately reversed in the camera).

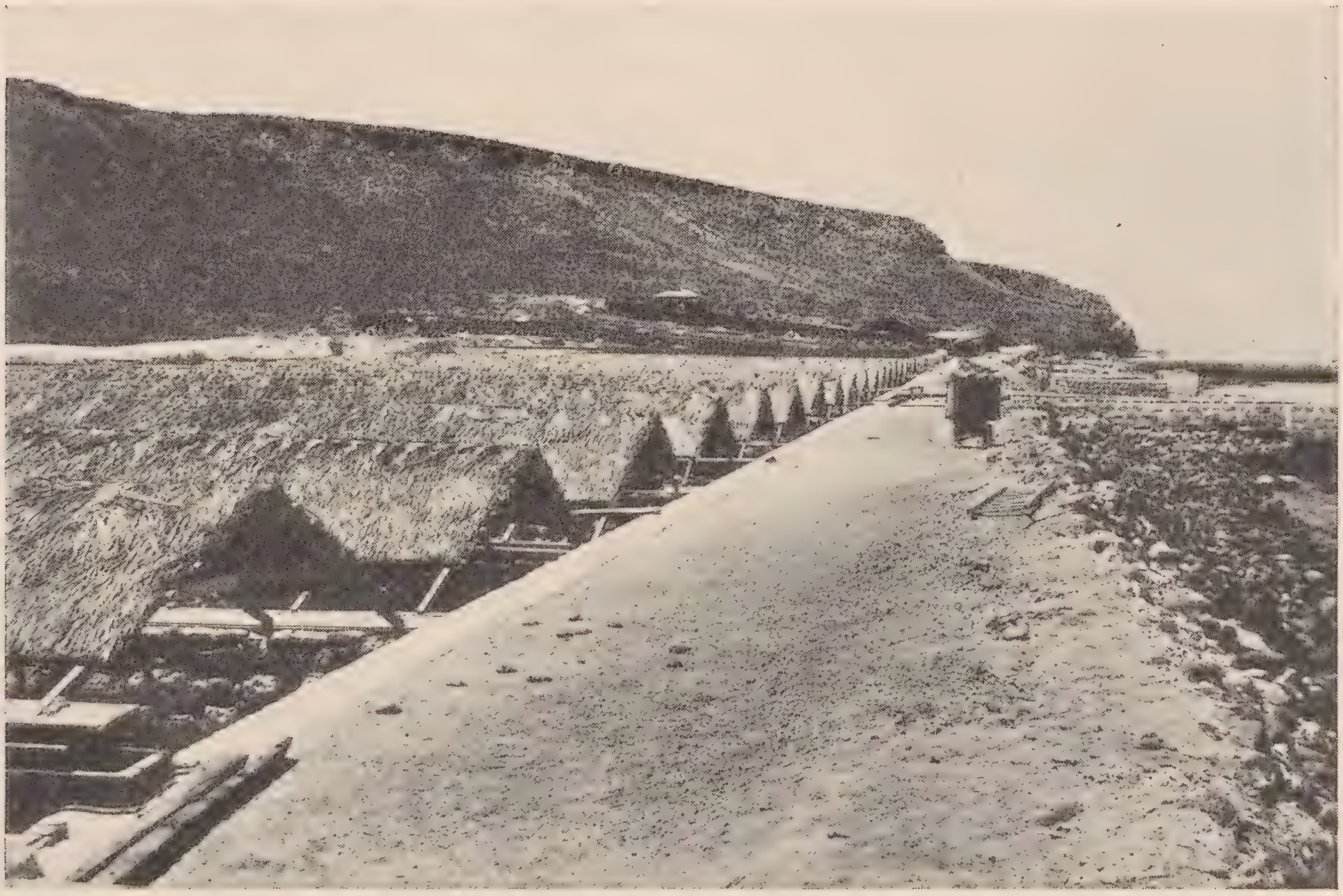
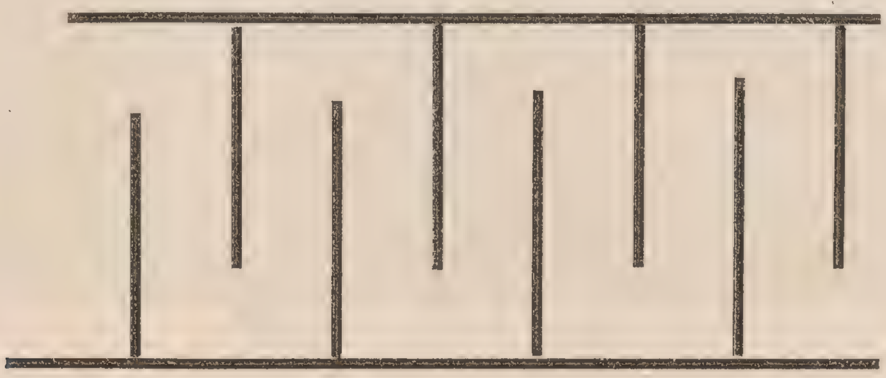


Fig. 28. Thatched roofs over the cross-sections of the canal; the open Bay on the right.

fishes and other enemies of the young pearl oyster, and through it the tide flows and ebbs, carrying minute forms of food for the growing young. The tide through it can also be controlled so that a sufficient covering of water for the young oysters can be maintained. The canal is provided with thatched covering throughout its entire length as a protection against undue heat when the tide is low. A general view of the station is shown in Fig. 27. The dividing barrier of masonry is seen extending to the opposite shore; nearer it is somewhat hidden by the thatch shelters of the cross sections of the canal. The general plan of the canal is indicated by the following diagram:



A closer view of the closely set roofed sections is presented in Fig. 28 taken from the protecting barrier of masonry, the open bay lying at the right. Beneath the sun shelters of each section the young shells are laid at low water, to be covered and fed by the tides. The shallow wire trays containing the shells are placed on lattice racks centrally located in each section, where they are supported above the bottom and exposed to the free flow of the water. As the shells grow larger their cultivation is continued on the rocky bottom of the canal. Some of the wire trays are shown in Fig. 29.

A view of one of the spat collectors is shown in Fig. 30. It is a heavy-framed, wire-covered crate, containing five shallow, latticed trays, closely set with short upright pieces of lath, to which the young free-swimming oysters attach when shell growth begins.

This collector has been brought to the beach from its original position in some part of the bay and hauled up the cemented grade by a chain and windlass. A nearer view of one of its trays is shown in Fig. 31, containing young shells from two to three months old.

Fig. 32 shows the trays of the crate removed, and employees ready to transfer young oysters to the shallow wire trays for placing in the canal. Each operator is provided with small wire trays.

The young shells at this stage are an inch or two in diameter, as indicated in Fig 29. They are more or less covered with marine growths of various kinds, which are for the most part removed.

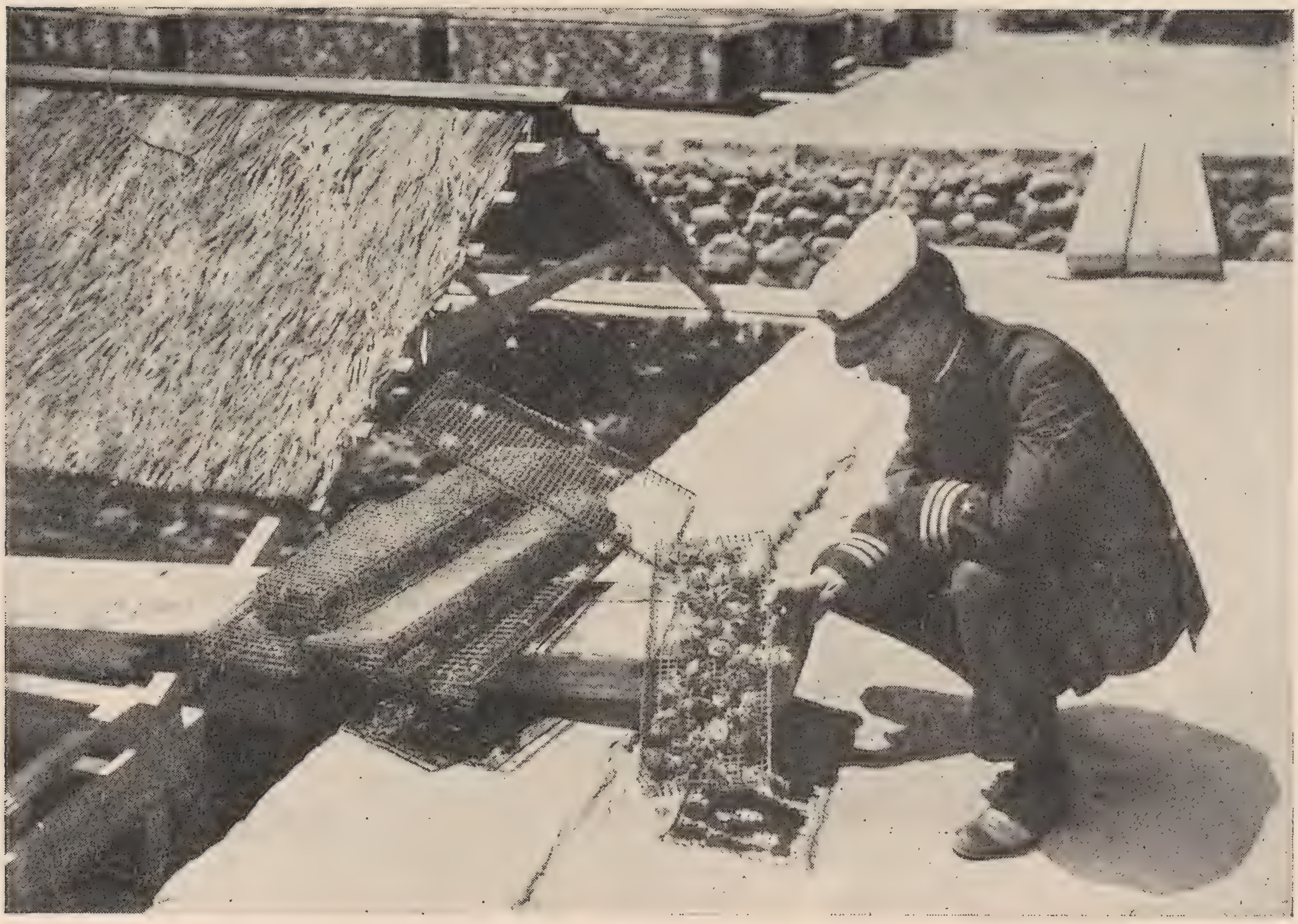


Fig. 29. Shallow wire trays on which young pearl oysters are laid for growth.

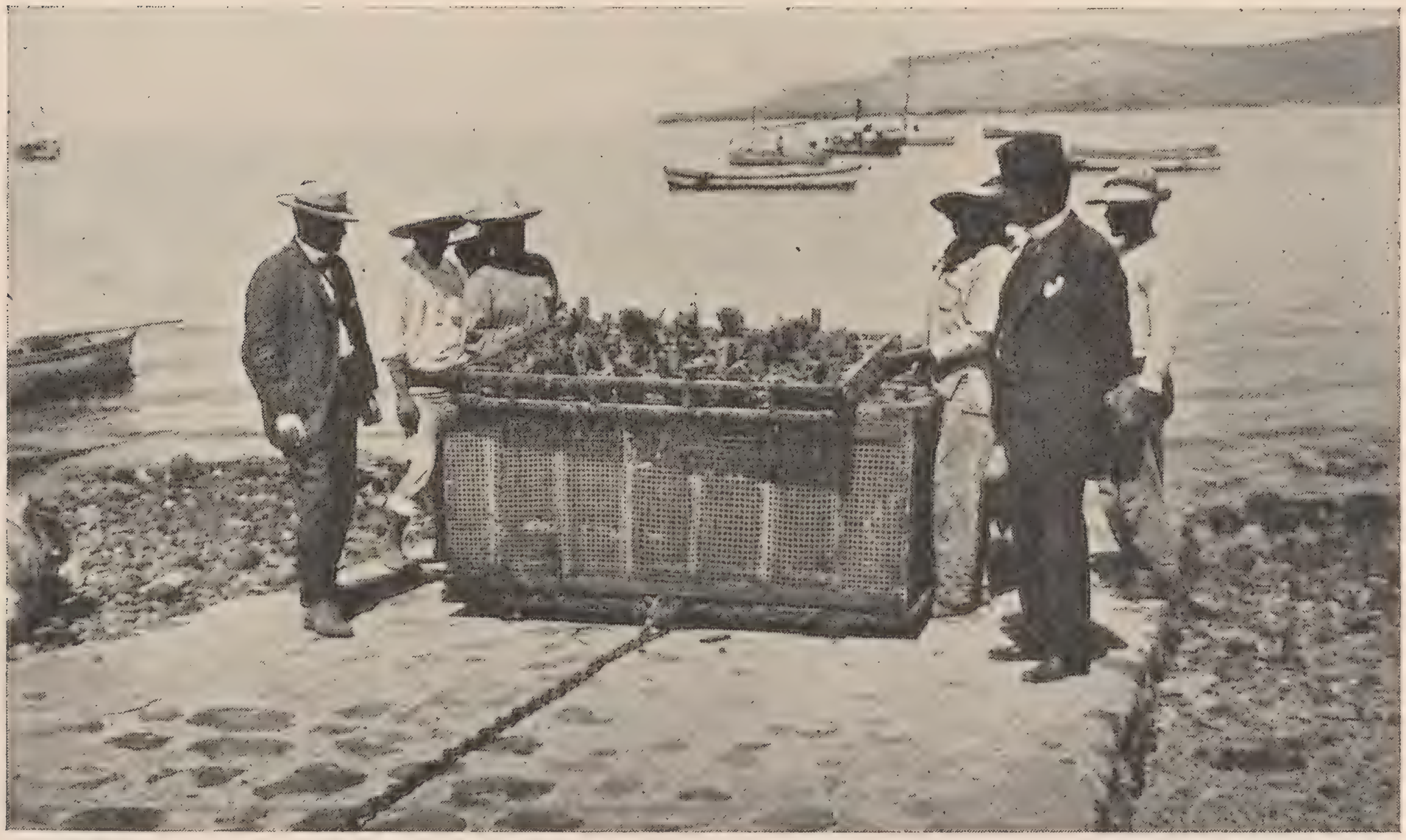


Fig. 30. A spat collector landed, with a full setting of young shells. One of the six trays is placed on top of the crate.

The station has several cemented grades where the heavy collectors are dragged up the sloping beach from the water (Fig. 33). Much of the manipulation is performed under the large thatched shelter shown at the right in the same photograph.

After a growth of eight or nine months in the protected canal, the pearl oysters are, as stated above, returned to the bay for final growth, or until they are about three years old.

All pearl oysters placed in the bay for growth are protected in wire-screened crates, and all crates whether containing spawn collectors or growing oysters, are lowered on prepared bottom which has been cleaned of marine growths, and roughly paved with rocks and stones by divers in diving armor.

The clean stony bottom on which the crates rest, serves also to catch more or less oyster spawn, but the bulk of the set of young shell is secured in the wooden trays of the wire-protected collecting crates. The bottom prepared by the divers is usually in coves, small bays or inlets.

Each collecting crate when put in proper position, is provided with numerous adult pearl oysters as breeders. Mr. Vives found by experience that some collectors, even when provided with breeders, came up without a good set of young. This he now guards against by putting as many as fifty adults in a crate as spawners, to insure the presence of both male and female oysters, the sexes being separate in the pearl oyster.

In Fig. 34 some of the matured shell is shown in boxes at the left, while a heap of shell being scraped and cleaned is shown at the right. Figs. 35, 36 and 37, show various forms of crates used in collecting and distributing growing shells and protecting them from their enemies.

There are several hundred spat collecting crates in use, some of them being sent out to favorable points many miles distant from the station at San Gabriel. All crates are protected by heavy, galvanized wire netting of about half-inch mesh. The spawning season of the pearl oyster in this region lasts from October until April or May. The intelligent efforts of Mr. Vives to secure an abundant set of spat in collectors located on the natural beds of the pearl oyster have undoubtedly been successful.

Two or three crops of matured shell had already been secured when the 'Albatross' called at San Gabriel in March, 1911, and subsequently an additional crop of shell was reported for that year.

Mr. Vives was apparently devoting all his energy to a successful solution of the problems of artificial cultivation and expressed the conviction that his work would prove successful.

There was abundant evidence that the methods of collecting spat were effective. There appeared to be also an abundance of apparatus for the different operations of pearl shell culture.

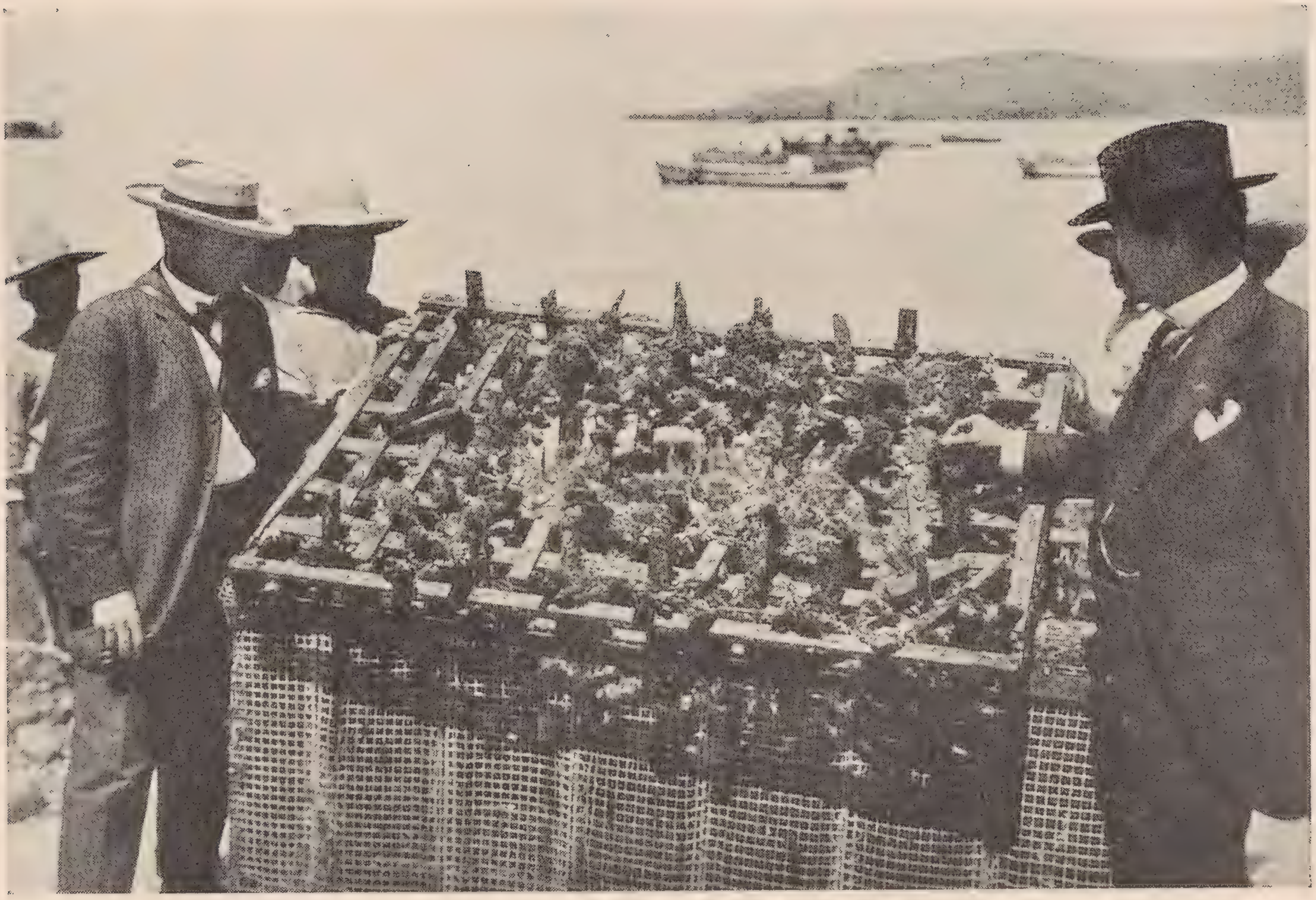


Fig. 31. Nearer view of the spat collector.

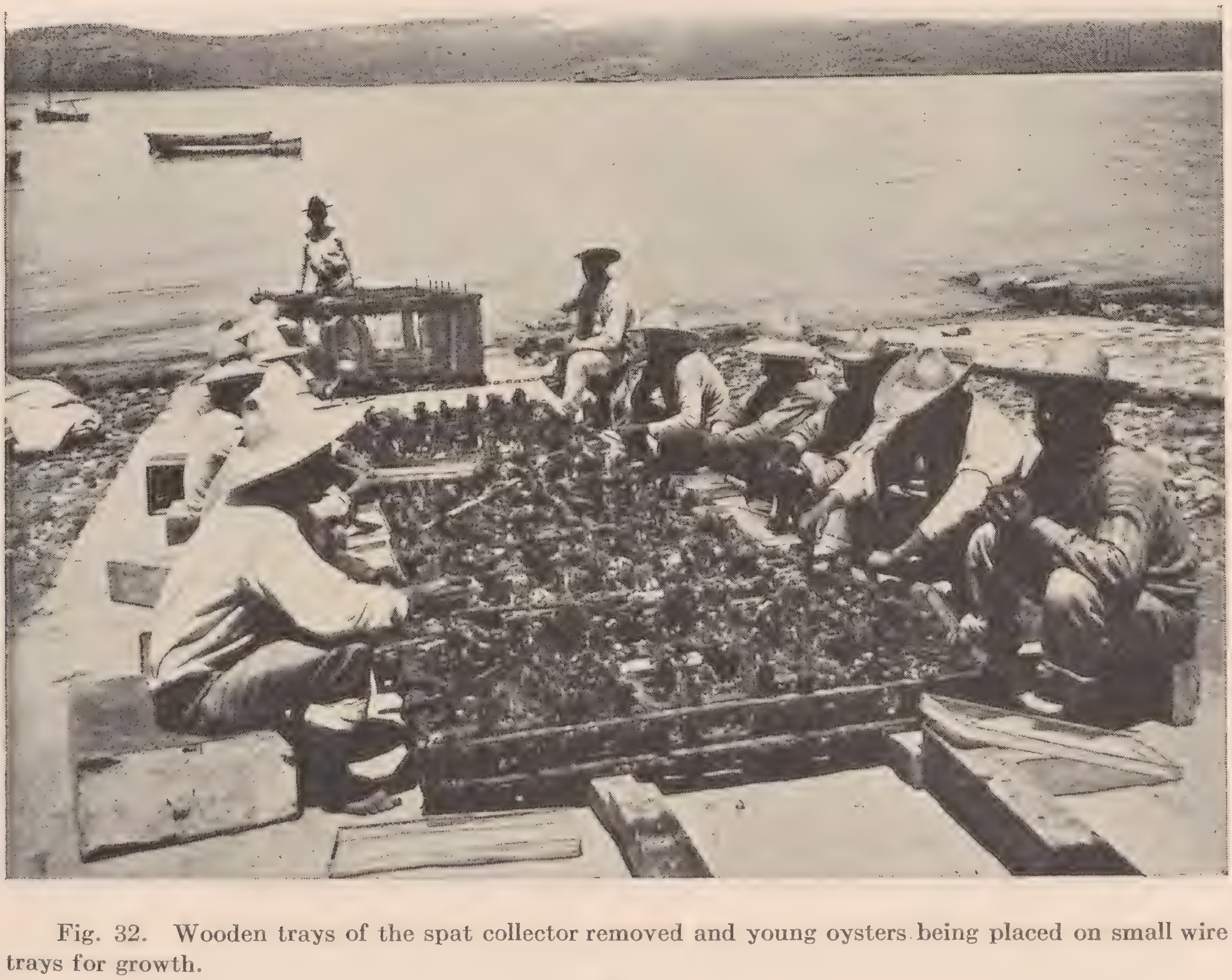


Fig. 32. Wooden trays of the spat collector removed and young oysters being placed on small wire trays for growth.

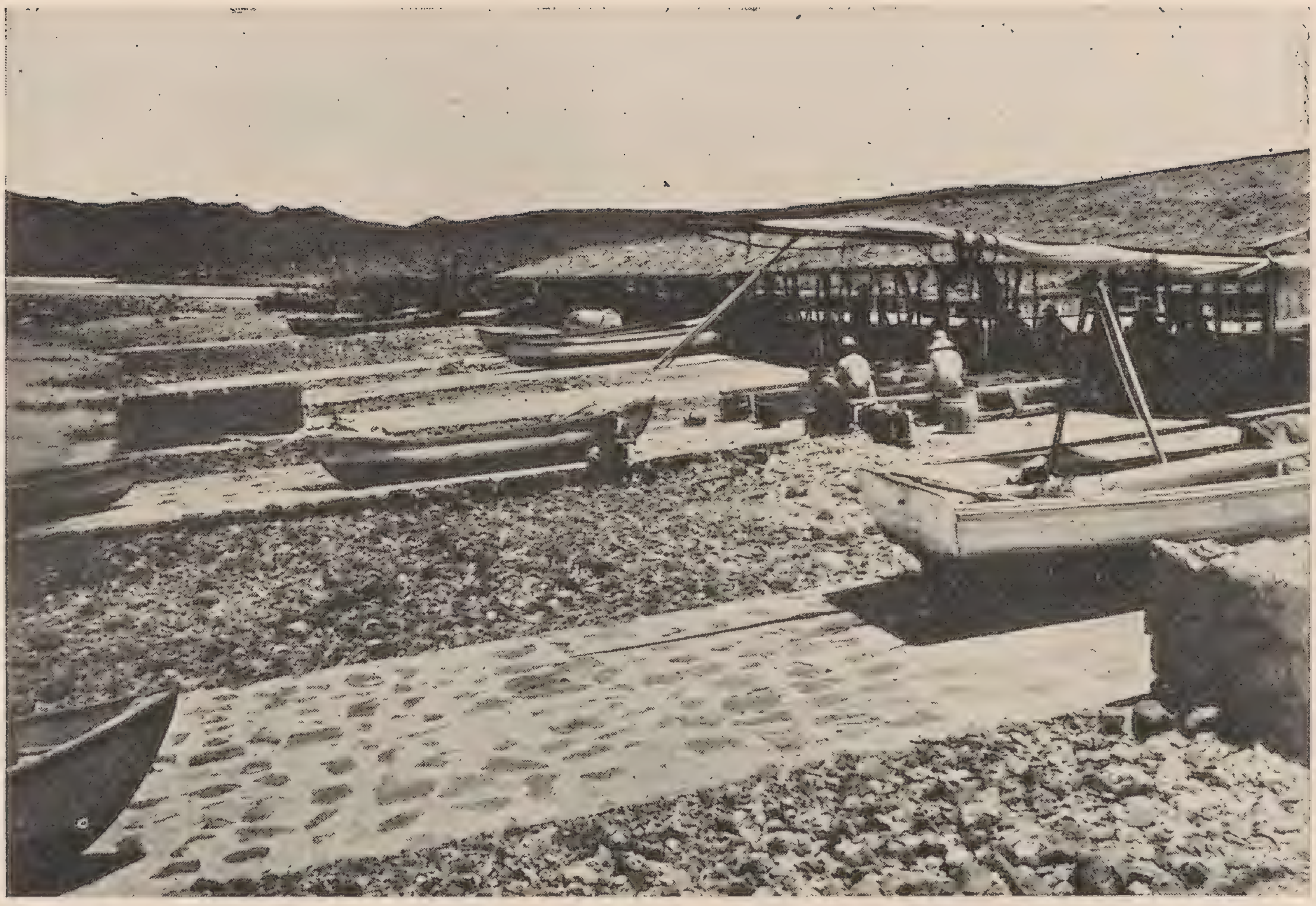


Fig. 33. Cemented grades on the beach to facilitate the handling of spat collectors and other oyster growing apparatus.

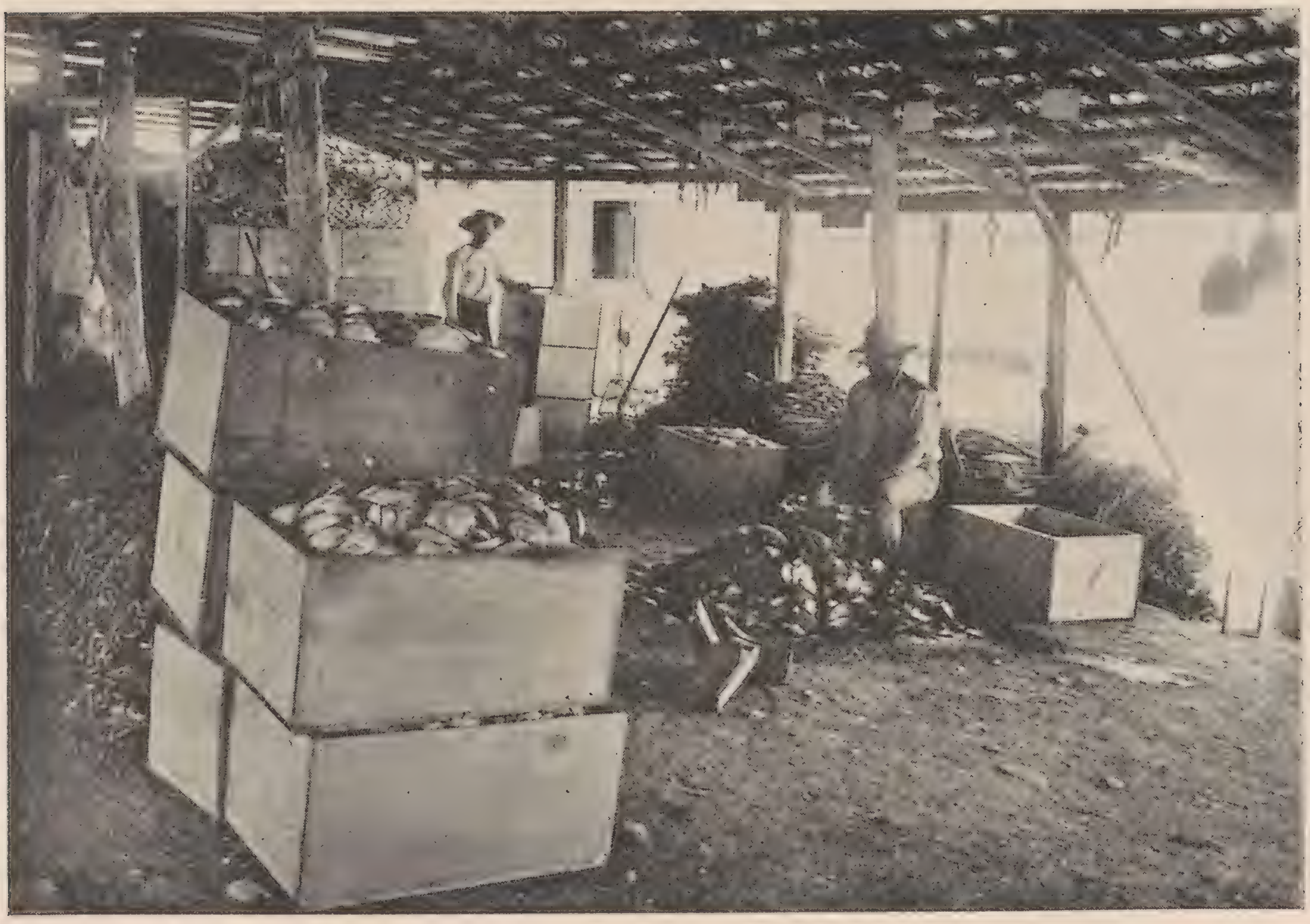


Fig. 34. Cleaning and packing shells of artificially-grown pearl oysters.

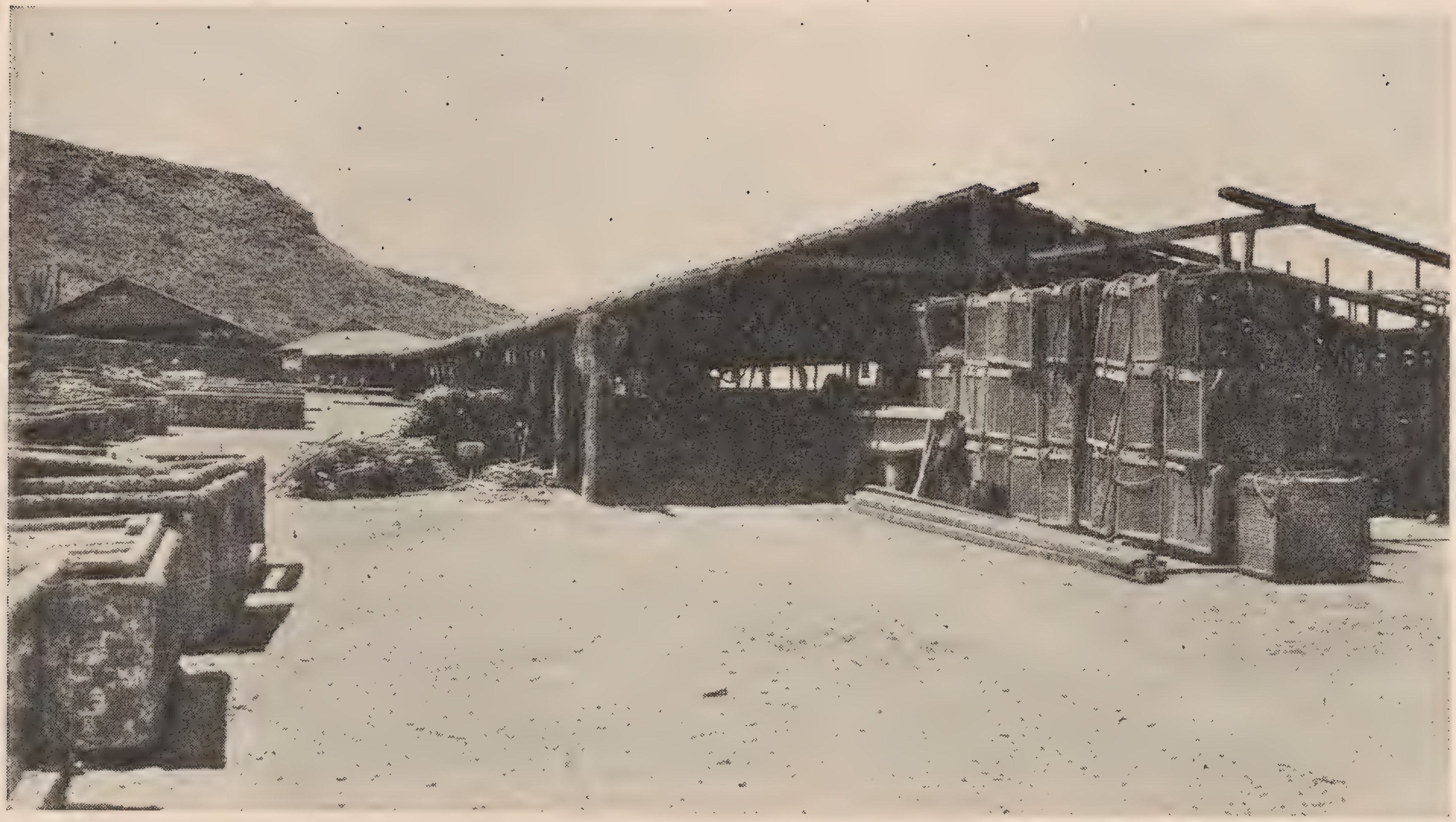


Fig. 35. Shelter and apparatus.

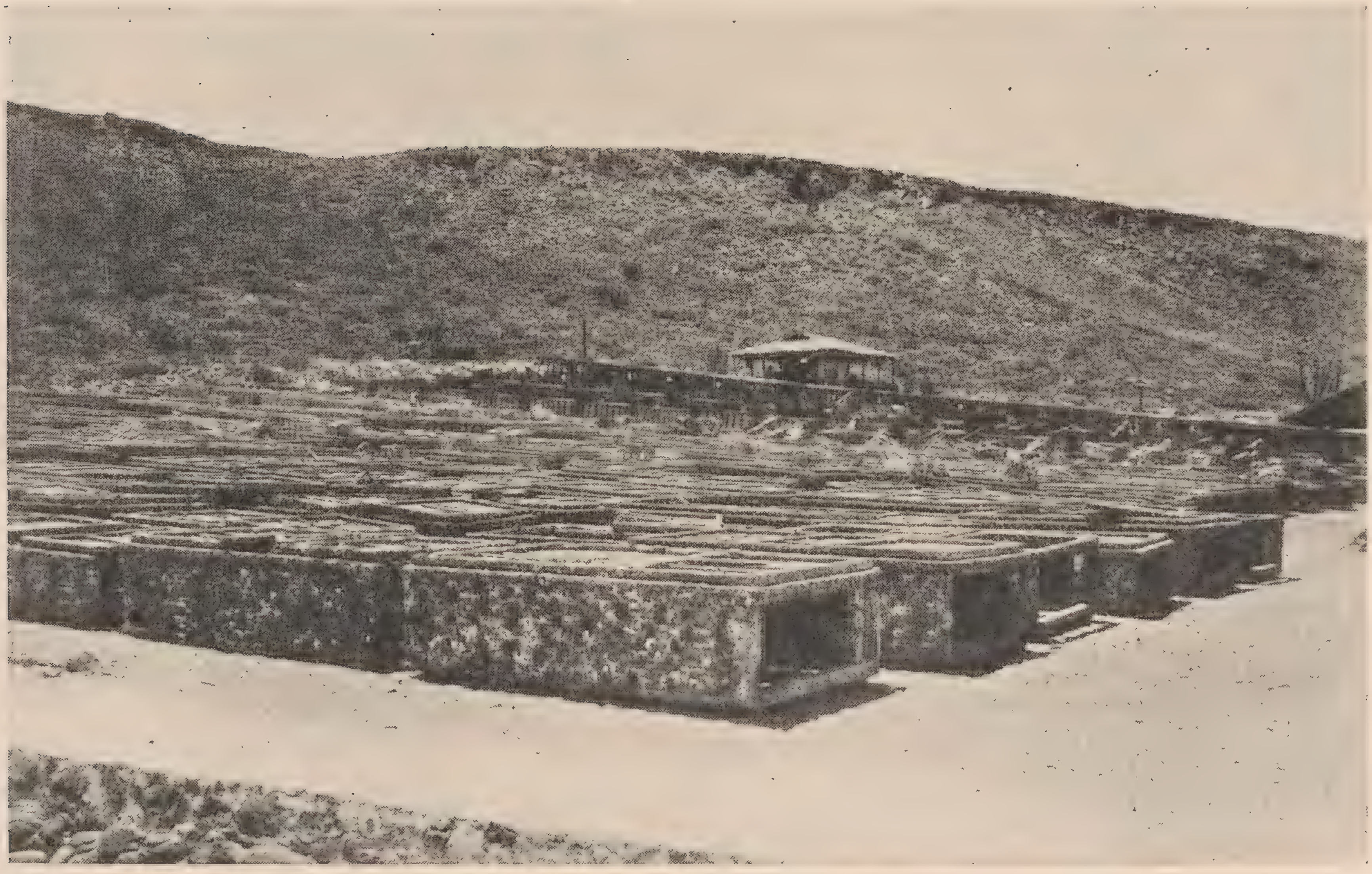


Fig. 36. Wooden apparatus for the protection and handling of pearl oysters laid out for growth.

Mr. Vives obtained his concession from the Mexican government in 1903. His brief report[1] relates to the years 1906–07. Considerable time must have been spent in preparation and experimentation.

From what is known of the pearl oyster in other regions, the shells grow large enough for industrial uses in about four years. They continue to grow after that period of course, but suffer deterioration from worms and boring sponges. What Mr. Vives had to say concerning the formation and growth of free pearls is interesting, and is presented here without comment as this has been a subject of much scientific and unscientific discussion.

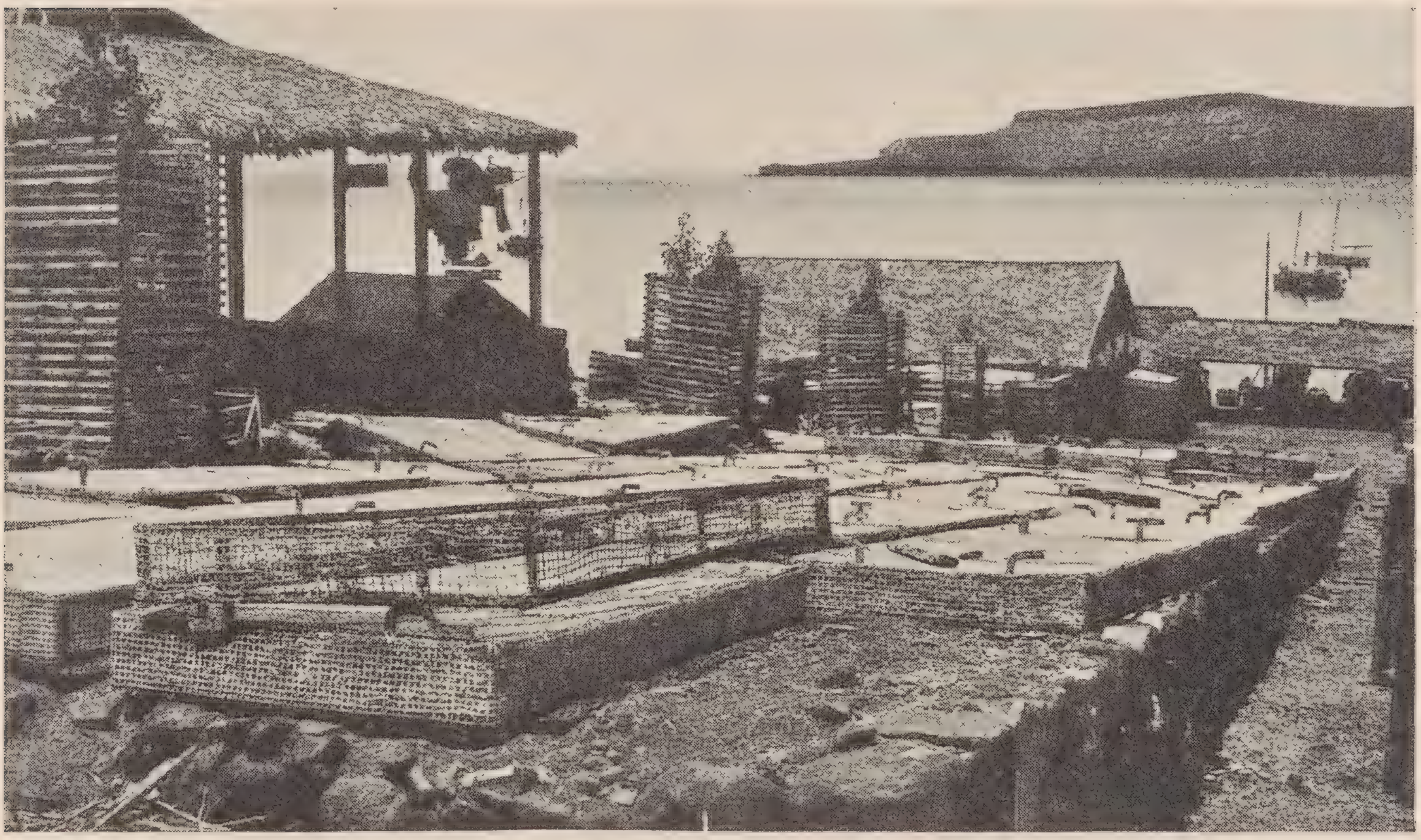


Fig. 37. Forms of wire apparatus for the protection and handling of pearl oysters laid out for growth.

New pearls are secreted by pearl oysters of all ages, but chiefly by the younger oysters. After the pearl oyster is three years old fewer pearls are formed.

Pearls are seldom found except during the period from August to December and rarely as late as December. Mr. Vives exhibited a small but perfect pearl in the flesh of an oyster of artificial growth known to be only three months old.

He finds the pearl to be formed within a watery blister (epithelial sac)

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[1] Compañia Criadora de Concha y Perla de la Baja California, By Gaston J. Vives. Informe rendido por la Dirección General â la Secretariâ de Estado y del Despacho de Fomento, Colonización é Industria, sobre los trabajos emprendidos durante los anõs de 1906 y 1907.

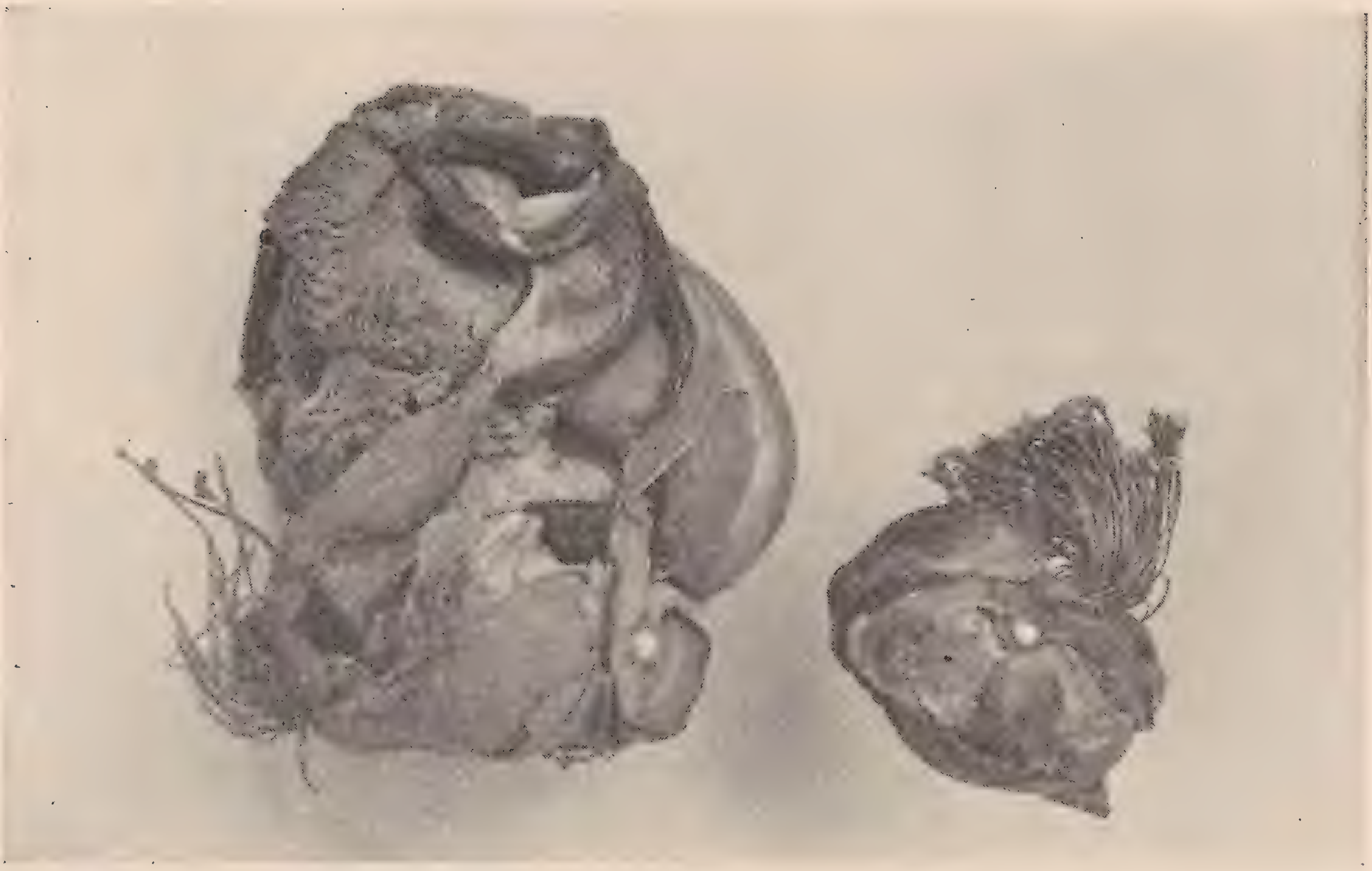

Fig. 38.

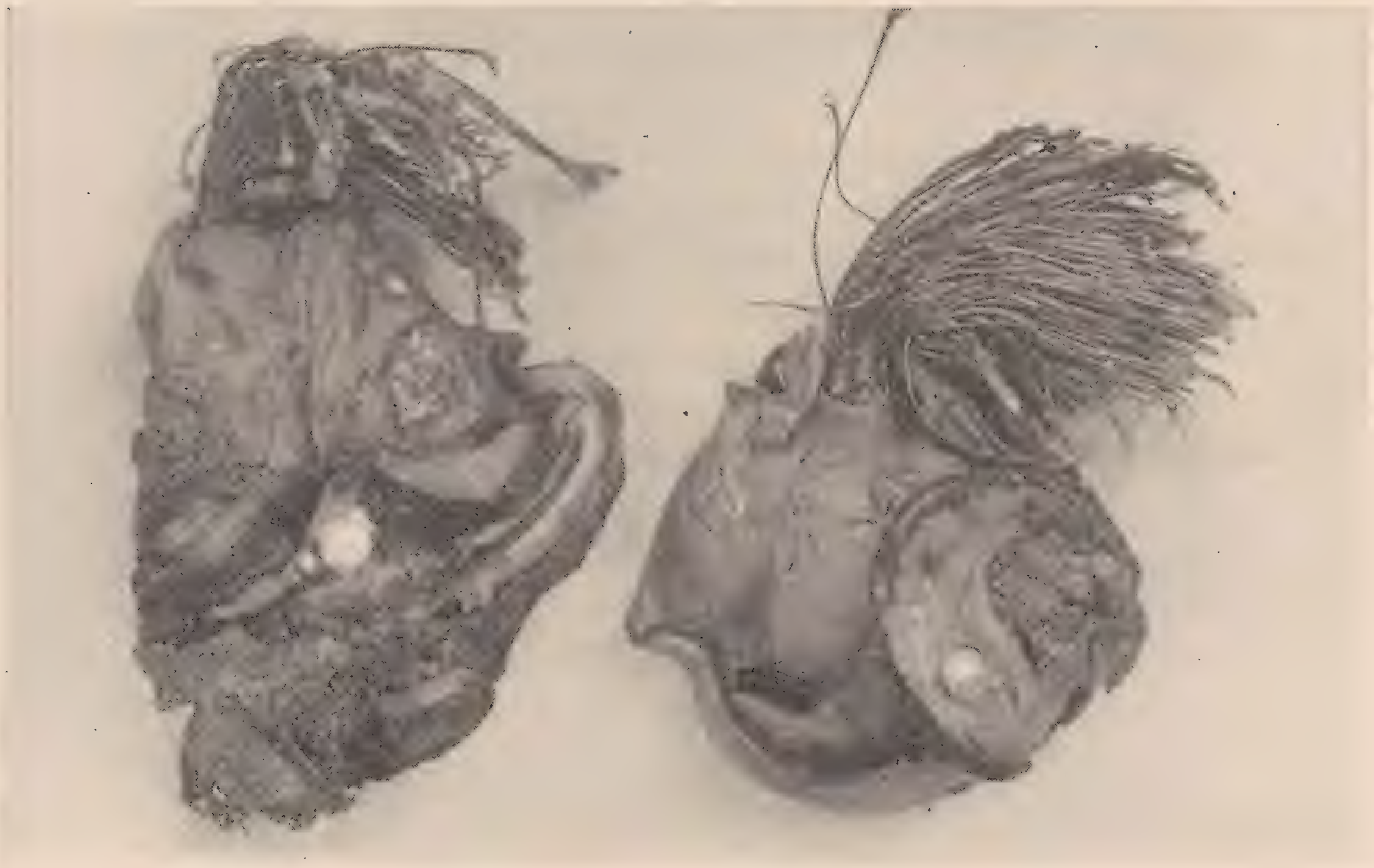

Fig 39.

Figs. 38 and 39. Photographs of pearl oysters (*Margaratifera* var. *mazatlantica*) showing newly formed pearls which have developed on various parts of the mantle.

In each specimen the thin sac has been cut open to expose the pearl sufficiently for good photographic results. The pearls are shown in about natural size, but the oysters have been shrunken in spirits. All of the pearls are located on some portion of the free mantle, generally on the branchial surface, some being on the inner surface. The pearls are apparently spherical and vary in size from about one to three grains.

Specimens presented to the American Museum of Natural History by Gaston J. Vives of La Paz.

located almost anywhere in the oyster, but chiefly in the mantle, and perhaps often thrown off and lost when the sac is ruptured. (See Figs. 38 and 39.)

The pearly growths of irregular form attached to the inside of the shell are of course caused by injuries of various kinds to the shell. It is now believed that pearls formed in the fleshy parts of the pearl oyster result chiefly from cestode parasites around which the oyster secretes a layer of epithelial tissue within which the pearl is eventually formed.

The inception at La Paz of an original method of pearl oyster cultivation is of more than passing interest, as the application of that method to the growing of pearl oysters in our own waters may be quite within the limits of possibility.

Spiny Lobster (*Panulirus interruptus*).— This large and valuable species is apparently common along the west coast of the Peninsula wherever there are rocky shores and reefs. Portions of their dried shells are common on the beaches in many localities, indicating a wide distribution.

At San Bartolome Bay, about 330 miles south of the United States and Mexican boundary lines, there were at the time of our visit four camps of fishermen engaged in lobstering, with two men at each camp. The camp at the entrance near the anchorage had 30 pots in use which were set in from one to twenty-five fathoms, according to the condition of the weather — the lobsters being found close to the shore in smooth weather. The pots are set outside the Bay in the vicinity of rocky ledges which are covered with kelp; they are four feet long, two feet wide at the bottom by one foot at the top, where the entrance is placed near one end. A pot of this kind will fill nearly full of lobsters. Both ends have narrow compartments at the bottom for ballast. (Fig. 12.)

The bait is principally abalones which are left attached to the shells, tied in small bunches with wire and suspended in the center of the pot. Fishes are also used to a small extent as bait. (Figs. 13, 14.)

The pots are made of lath, 1½ inches wide and ¼ inch thick, the framework being heavier. Two men working together catch about a ton a week for which they receive 4c. a pound. The camps at San Bartolome were supposed to be visited weekly by a small steamer of the International Fisheries Company of Los Angeles, but at the time of our visit in March the steamer was three weeks overdue and most of the catch had spoiled. The fishermen were nearly out of fresh water and they would have been under the necessity of going to Cedros Island, about thirty-five miles distant, had we not furnished them with a supply from the ship. When we returned to San Bartolome late in April there was but one camp of these fishermen remaining, as the locality was desolate and totally without fresh water. The steamer was again long overdue and the fishermen short of water and provisions. The industry did not appear to be a flourishing one although lobsters were abundant. The method of transportation makes it difficult to carry the catch through alive. The lobsters were transported in crates, a halfway stop being made at San Quentin to revive the lobsters by lowering the crates into the water over night. This species has always been taken in limited quantities in southern California, but the local supply is not large.

The lobster resources of Lower California could be utilized at less expense if regular steamer shipping facilities were available. The lonely, almost waterless shores of the Peninsula are seldom visited, and there is doubtless considerable difficulty in getting fishermen to remain for long periods in the isolated camps.

San Bartolome is apparently the only point in Lower California where a lobster fishery is carried on, and the work there appears to be intermittent.

Green Turtle (*Chelonia virgata*).— This species is found in abundance on both sides of the Peninsula. There is probably no better place for obtaining turtles than San Bartolome Bay. According to the fishermen located there, turtles are present during most of the year, being inside the bay chiefly during the winter months. They are reported to haul out on the beaches for egg laying in April and May. A few were being sent to market, but there appeared to be little demand for them.

When the 'Albatross' visited San Bartolome on April 11, 1889, a very remarkable catch of green turtle was made. The U. S. S. 'Ranger' was there at the same time and a seining party was made up consisting of members of the crew of that vessel and of the 'Albatross.' In a single haul of a seine 600 feet long we brought to shore 162 green turtles, many of them of large size. Probably half as many more escaped from the seine before it could be beached; there being a continual loss by turtles crawling over the cork lines during the entire time we were hauling it. The great bulk of this catch was, of course, liberated, although both vessels took on board all that could be used. There are doubtless other bays around the Peninsula which are frequented by turtles at the egg laying season and where large numbers might be obtained by seining.

Turtles are plentiful in the Gulf of California, and the 'Albatross' obtained specimens in the vicinity of Willard Bay, on the Peninsula near the head of the Gulf in 1889. During the present cruise, we found deserted turtle camps and an abundance of turtle shells at Tiburon and other islands in the Gulf. Turtles are said to abound near the mouth of the Rio Colorado where their eggs are deposited in the sands. The inhabitants of the Peninsula seem to have no difficulty in obtaining a supply of them. Turtles are sometimes shipped to San Francisco by steamer from Magdalena Bay.

Hawksbill or Tortoise-shell Turtle (*Eretmochelys squamata*).— The hawksbill is fairly common about the lower end of the Peninsula and the islands in the lower part of the Gulf. It is reported to be more abundant about the Tres Marias Islands below the mouth of the Gulf. The employees of the pearl shell companies at La Paz obtain quantities of tortoise shells, but some of these are received from localities along the mainland of Mexico. I obtained two very fine specimens at La Paz for museum purposes, which measured along the top shell 34 inches and 31 inches respectively. Some of the largest specimens obtained are roughly mounted and polished for exhibition purposes.

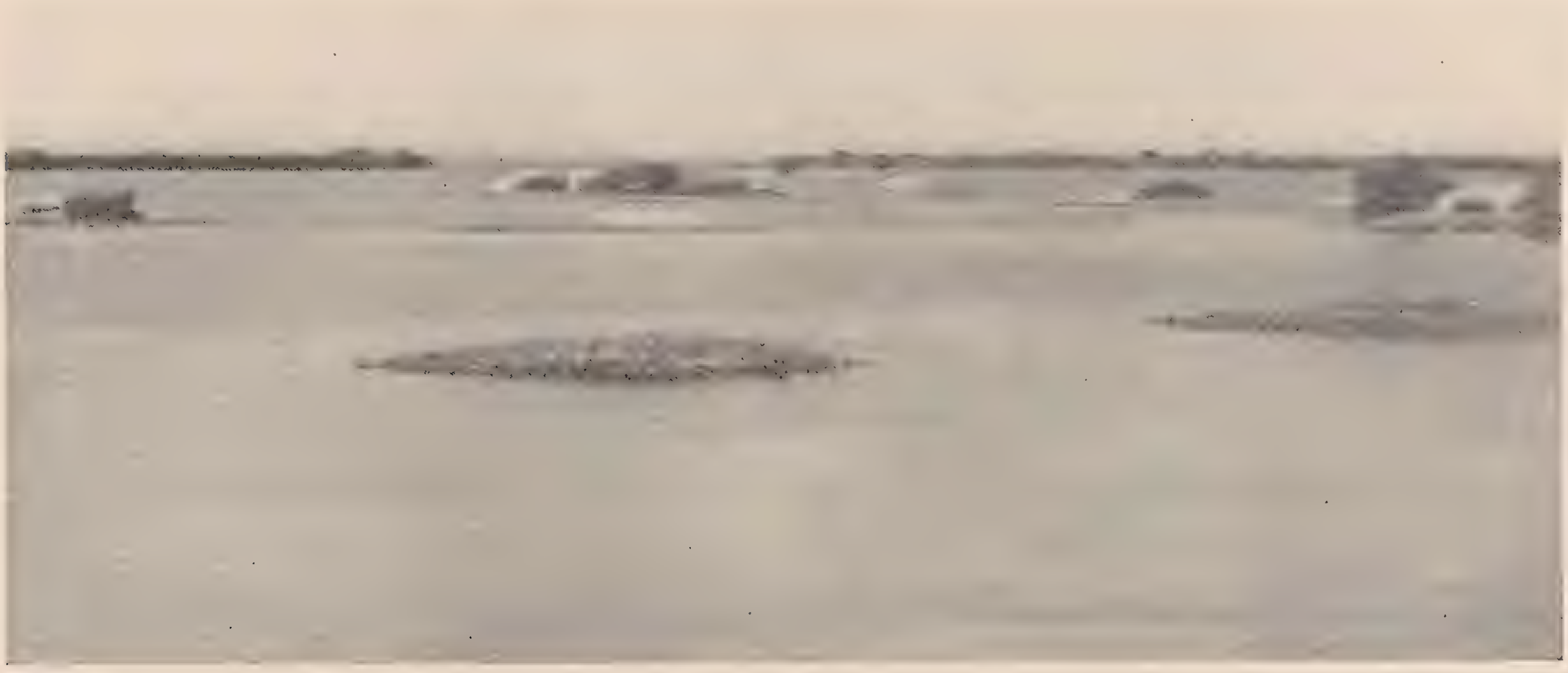

Fig. 40. Oyster reefs at low tide. Algodones Lagoon, above mouth of Yaqui River, Gulf of California.

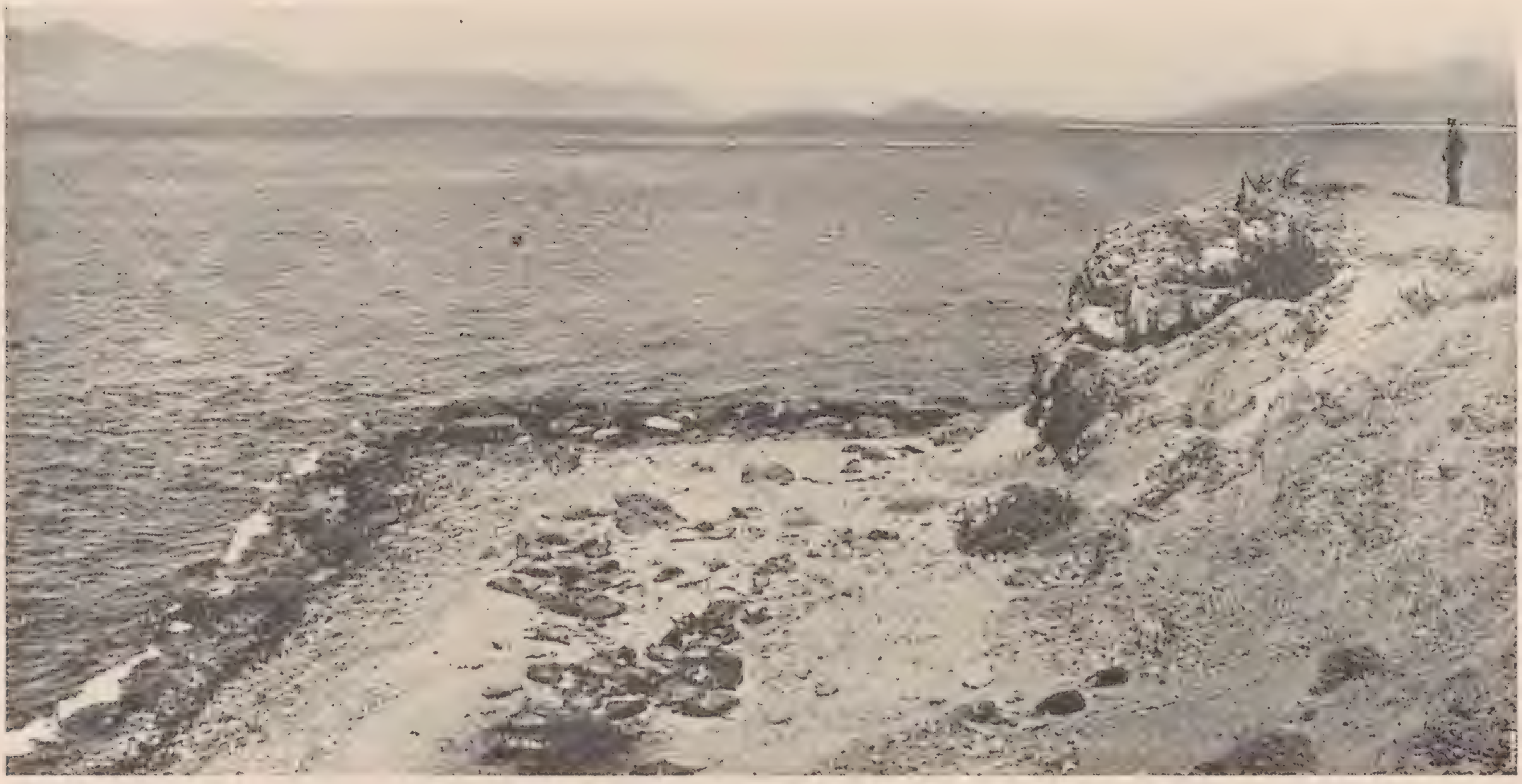

Fig. 41. Seal Rock near San Josef Island, Gulf of California. Showing numerous shells of green turtle left on the beach by fishermen. San Josef Island in distance on the right.

Oysters.— The oyster of the Gulf of California appears to be more abundant about the mouth of the Yaqui River, near Guaymas, than it is anywhere north of that point. The species is not apparently distinguishable from *Ostrea virginica* and has indeed been referred to *virginica* by some conchologists.

Algodones Lagoon, just north of the river delta, is a great reservoir of oysters of excellent quality. These oysters have always been used locally and are gathered chiefly by Yaqui Indians for sale at Guaymas. They are shipped to some extent to points in the interior. (Figs. 40, 42.)

Oysters are found at several points toward the head of the Gulf as at Georges Bay, on the east side and Angeles Bay and at Carmen Island on the west side.

Abalone.— Several species of the large and valuable "Abalone" (Haliotis) are found along the coast of Lower California and may be quite as abundant as they are along the shores of southern California.

The abalone is the basis of an important fishery in California where its meat is used for food and the ornamental shell used for jewelry and inlaying material. Most of the abalone meat is dried for export to China.

During a former visit to Lower California the writer found camps of Chinese fishermen located at San Bartolome Bay and at the San Benito Islands, engaged in gathering abalones. Great quantities of the meats were spread out on the ground and dried in the sun until they were quite hard. The shells were also saved.

During the voyage of the Albatross we met with no abalone fishermen, but they may have been located at points not visited by the expedition. There can be no doubt as to the abundance of abalones along the northern part of the Peninsula and the outlying islands.

The value of abalone shell varies according to the species, the green shells being worth from $100 to $150. a ton, while black shells of the best quality are two or three times as valuable.

Food Fishes.— Lower California has important fishery resources both on the Pacific and Gulf coasts, which are as yet undeveloped.

The population of the region is quite limited and while there is desultory fishing at all towns and villages, there are no fish markets worthy of the name. The methods of handling the catch are crude. Fresh fish must be sold promptly as ice is not available and there are no fishing boats fitted with wells in which fish can be transported alive. Much of the catch is roughly salted and is uninviting. The introduction of well-smacks, such as those used in Florida and some parts of the West Indies would work a transformation in this respect.

During the different voyages of the 'Albatross' to this region good food

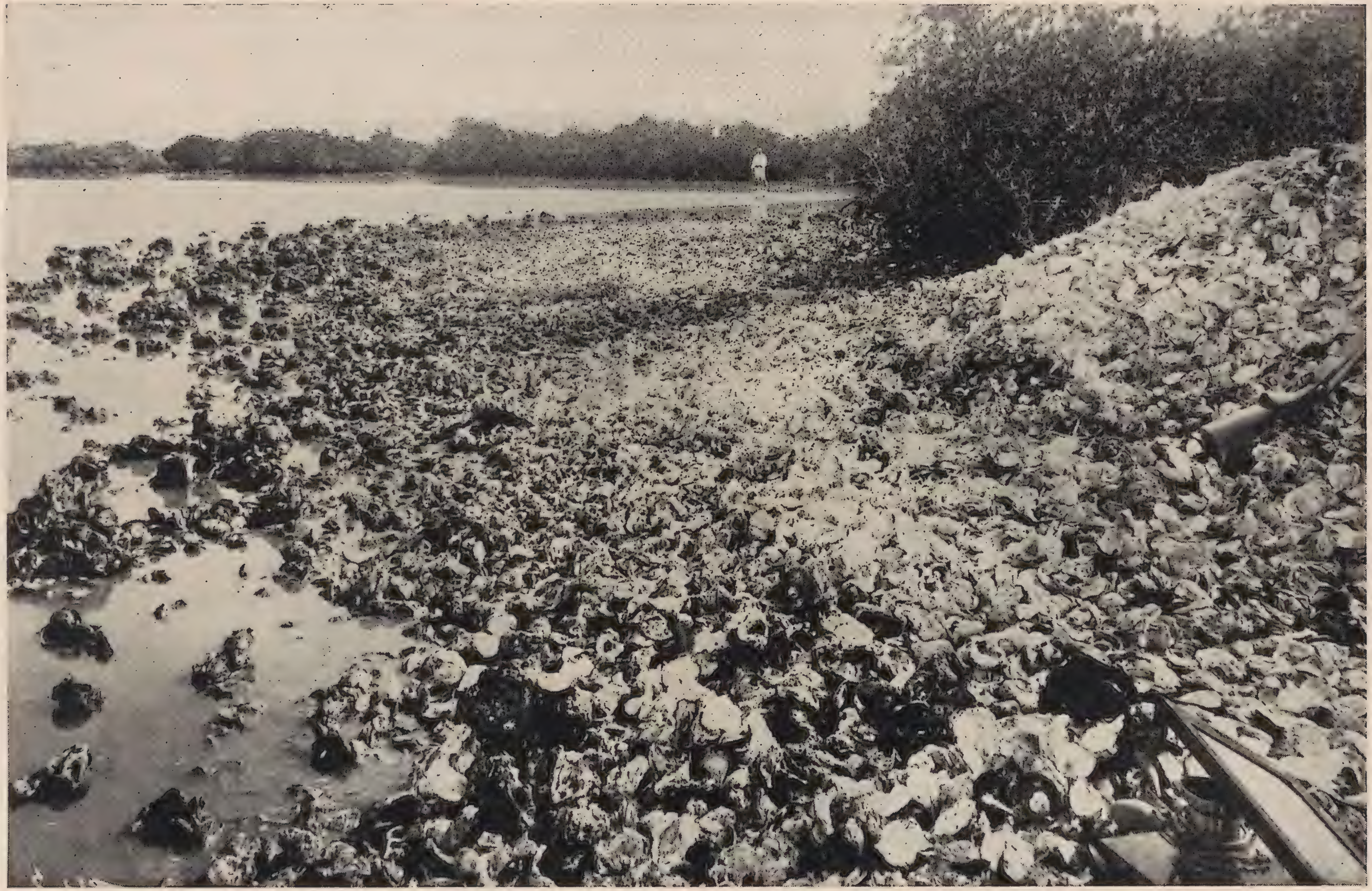

Fig. 42. Natural oyster beds at low tide. Algodones Lagoon, above mouth of Yaqui River, Gulf of California.

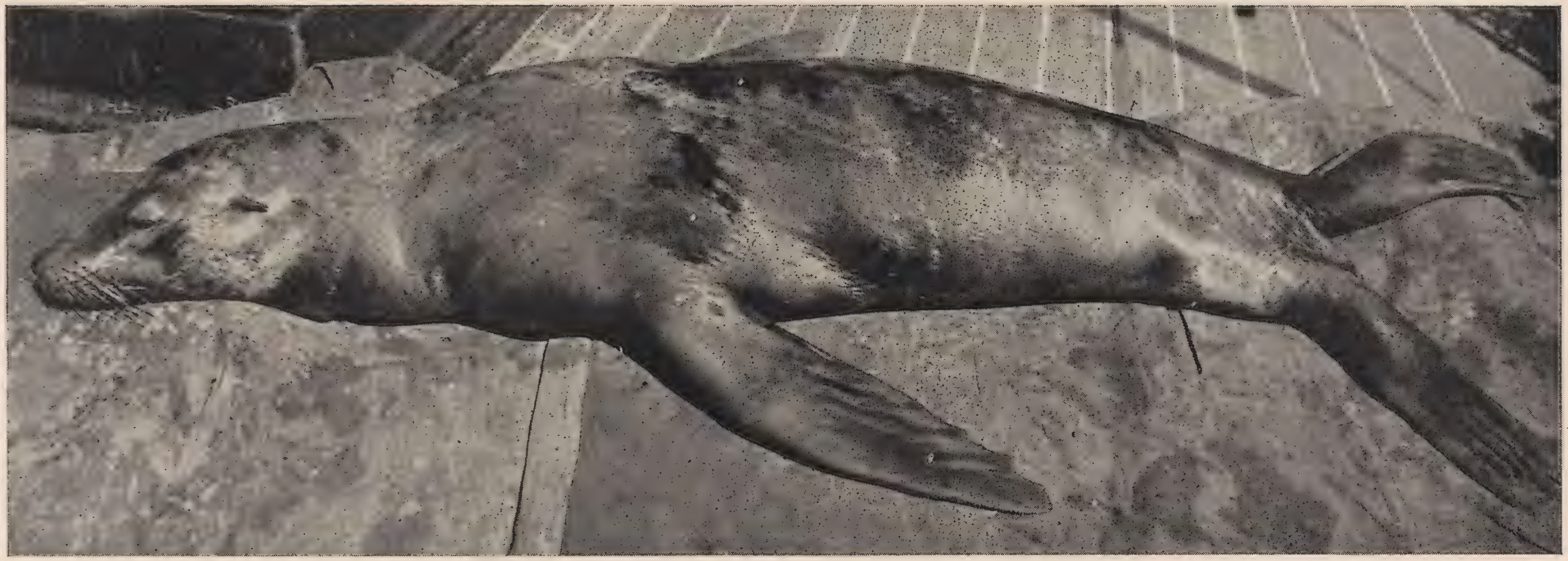

Fig. 43. California Sea Lion (*Zalophus*). San Luis Islands, near head of the Gulf of California.

fishes were found at most anchorages and were obtained with both seines and hand-lines.

Several species of food fishes of the Atlantic coast occur also in the Gulf of California. Among these may be mentioned the Spanish mackerel (*Scomberomorus maculatus*), Chub Mackerel (*Scomber colias*), Mullet (*Mugil cephalus* and *M. curema*), Jack (*Trachurops crumenophthalmus*), Crevallé (*Caranx hippos*), Horse-eye Jack (*C. latus*), Jurel (*Caranx caballus*) and Jewfish (*Promicrops guttatus*). The 'Albatross' met with most of these about the islands in the Gulf, but there are many native food fishes of importance, some of which were first made known to ichthyology through the earlier investigations of the 'Albatross' in this region. The most important of these is *Cynoscion macdonaldi,* locally known as "Totuava" and "sea Bass," the largest of the weakfishes, reaching a weight of 175 pounds. It is an excellent food species, common along the eastern shore of the Gulf and southward as far at least as Guaymas where it occurs during the winter months. The 'Albatross' found it in abundance at the head of the Gulf in March, 1899. Specimens taken with heavy cod gear had to be pulled aboard with the aid of gaff-hooks, three of them weighing 79, 82 and 140 pounds respectively. This species enters the brackish waters of the mouth

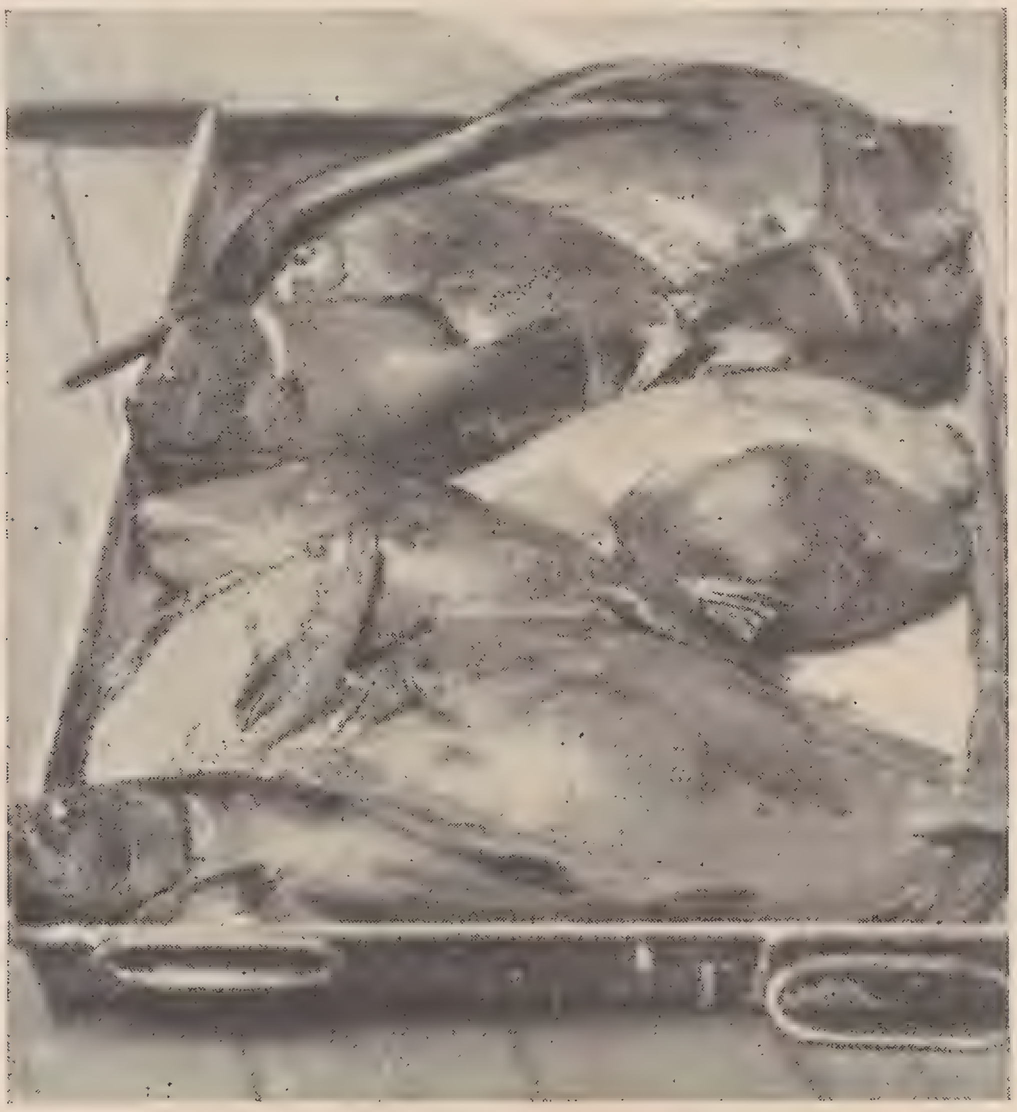

Fig. 44. Fishes from Santa Cruz Island, Gulf of California.

of the Rio Colorado and is sometimes taken there by spearing. (See Fig. 45.)

Another weakfish of the finest quality is *Cynoscion parvipinnis,* common to both sides of the Peninsula. It is called "bluefish" in Southern California.

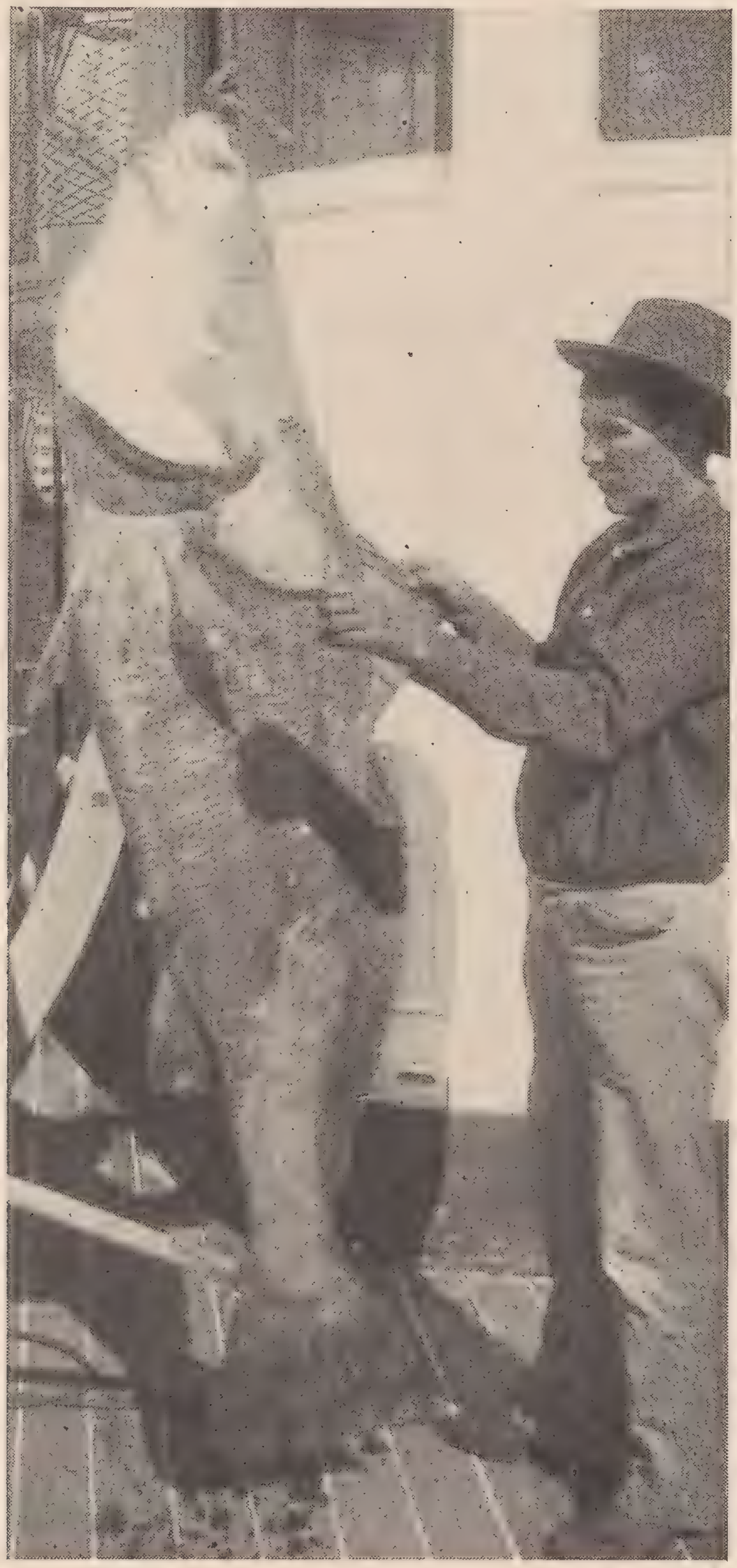

Fig. 45. Giant Weakfish (*Cynoscion macdonaldi*) weighing 140 pounds. This species was found in abundance near the head of the Gulf of California.

The large Pez de Gallo (*Nematistius pectoralis*) is abundant in the upper part of the Gulf, and reaches a length of four feet.

Among the more or less abundant food fishes of the Gulf are Barracuda (*Sphyræna argentea*), Spotted Cabrilla (*Serranus maculato-fasciatus*), Cabrilla de Astillera (*Mycteroperca jordani*), Pargo Amarillo (*Neomænis* *argentiventris*), Flamenco (*N. guttatus*), Burro (*Pomadasis macracanthus*), Mojarra Garabata (*Calamus brachysomus*), Yellow-tail (*Seriola dorsalis*), Redfish (*Pimelometopon pulcher*), Mojarra Dorara (*Gnathanodon speciosus*), Garlopa (*Mycteroperca venadorum*), Grouper (*Dermatolepis punctatus*), Cabrilla Piritita (*Mycteroperca pardalis*), Codorniz (*Umbrina xanti*), Mojarra Blanca (*Xystœma cinereum*).

Good food fishes are known to be abundant about Guaymas, but they are doubtless just as abundant at many other points on the Gulf.

Mullets of large size are very abundant at the mouth of the Rio Colorado, running up the river as far as there is brackish water.

In cruising about the Gulf the many large-sized fishes to be seen leaping indicate their abundance.

A few angler-yachtsmen from California have found their way into the upper part of the Gulf and enjoyed the best of sport with rod and reel. The fish reported by them as "tarpon" is without doubt the bone fish (*Elops saurus*), first cousin of the tarpon. It is a hard-fighting game fish, three feet in length and common at Guaymas. This species is also found on the Atlantic coast.

The Gulf of California is 700 miles long with an average width of about 100 miles. Its fishery resources are of great importance and undoubtedly worthy of development. The only existing means of communication with the United States is the Sonora Railway extending from Nogales, Arizona, to Guaymas, situated about midway on the Gulf. The head of the Gulf extends to within forty miles of the Arizona-Mexico boundary at two points, the mouth of the Rio Colorado and Adair Bay, situated fifty miles east of the mouth of that river.

If access to the northern part of the Gulf with its abundant supply of food fishes, oysters and turtles could be secured, it would be possible to inaugurate a fish trade under American auspices, between points on the Gulf and the large fishless section of the United States represented by New Mexico, Arizona, Nevada and southeastern California. An outlet to the extreme head of the Gulf of California, through a strip of American territory which might be acquired by purchase from Mexico, would be of great benefit to the people of both countries. It would lead not only to the development of latent fishery resources, but would open to traffic a great navigable waterway that has hitherto been tightly sealed.

Appendix A.

DREDGING AND HYDROGRAPHIC RECORDS OF THE U. S. FISHERIES STEAMSHIP 'ALBATROSS' DURING THE VOYAGE TO THE GULF OF CALIFORNIA IN 1911.

Explanation of Tables.

The last previous dredging station of the 'Albatross' was No. 5672, and the last hydrographic station was No. 4937, occupied during the Philippine Expedition, 1907–1910. (See Bureau of Fisheries Document No. 741.) Twenty-seven dredging and sixteen hydrographic stations were occupied during the Lower California Expedition, extending the series of dredging stations to No. 5699, and the hydrographic series to No. 4953. In the tables the series are distinguished by the prefixed letters D and H, respectively.

Only those stations where the ship's gear was used (*i. e.*, with the ship as an instrument) to collect natural history specimens have been designated in the records as dredging stations. No numbers have been given to the shore stations, nor to minor collections made with the ship at anchor. Numbers should be given in the dredging series to hauls of the large intermediate net when used in a tideway with the ship at anchor, but this net was not used during this cruise.

Since the shore work constitutes such an important part of the total, the data regarding shore stations is shown in chronological order with the dredging stations, the locality, apparatus, etc., appearing in the appropriate columns. To economize time most of the reef collections of fishes were made with dynamite. The method was to locate the desirable fishes in the coral growth or among the rocks by means of a view glass (a glass-bottomed box) used from a boat. A small charge of dynamite with electrical connections was carefully lowered and discharged. Such fishes as floated were at once collected with a dip net, and the place marked by a buoy. As soon as the bottom had cleared it was searched and the dead fish gathered by means of long-handled spears. Seining operations were carried on wherever suitable beaches could be found within reasonable distances from where the ship was anchored. A general location of the beaches is shown in the column headed "Remarks." The dynamiting operations were usually about the reefs and rocks in close proximity to where the ship was anchored, and it is impracticable to give the locations more definitely.

The various kinds of apparatus used at each station are recorded in the tables in chronological order, each on a separate line, opposite the station number, or, in case of unnumbered stations, opposite the locality, in the column "Apparatus."

The "Position" of a station is that point occupied by the vessel, as determined by the navigator at the time of beginning the first operation at that station. The position of the subsequent operations under the same station number corresponds in a general way to the line as indicated under "Drift." The distance covered by all the operations of a station is usually, however, not greater than the negligible error of observation, except in stations near shore determined by bearings. In conformity with previous practice, an additional position, by true bearing and distance, of some prominent shore feature is given for each station when practicable.

All bearings are true unless otherwise indicated.

In the column "Chart" is noted the number and edition of the chart used at each station.

The spelling of all geographic names in these tables is that found on the charts designated in the column "Chart."

"Time of day" in the case of soundings indicates the time the plummet struck bottom; in the case of dredgings, the time at which the apparatus began to tow on the bottom; in the case of intermediate nets, the time at which the nets started to tow at the depth indicated; in the case of surface hauls, the time at which they were lowered into the water and began to be towed or the current to pass through them.

"Depth" (in fathoms) is the depth obtained by the sounding when a sounding was made. In cases where no sounding was made the depth is estimated from the chart, unless the station immediately follows another, in which case the depth obtained at the preceding station is given. In seine hauls the depths given are approximate, and represent the greatest depth of water through which the seine was hauled.

"Temperatures." The air temperatures are taken from the ship's log for the hour nearest the hour entered in the time column; the same is true of the surface temperatures. The bottom temperature was taken at the time of sounding. All readings by Fahrenheit thermometers.

"Density." The water density is in all cases reduced to 15′ C. The density of bottom water was ascertained from a sample taken by the Sigsbee water bottle.

In the double column "Trial" is indicated the depth at which apparatus was worked, as well as the duration of operation. In the case of bottom apparatus this latter is the time during which it is supposed to be dragging on the bottom, up to the beginning of reeling in; for intermediate nets the time occupied in towing at the depth shown in the depth column is indicated by the first quantity, the time occupied in hoisting by the second; for surface nets the time indicated is the time actually towed at the surface.

In the double column "Drift" is shown approximately the general direction in which the gear was hauled, as well as the distance. The state of the currents and of the wind, with the exigencies incident to the steering of the ship, make this more or less inaccurate.

The apparatus used during this expedition consisted of the usual beam trawls for all work on the bottom. No intermediate work was carried on, and the surface nets were used very seldom.

Appendix B.

RECORD OF AIR AND WATER TEMPERATURES OF THE U. S. FISHERIES STEAMSHIP 'ALBATROSS,' MARCH 1 to APRIL 28, 1911.

Date 1911	Air: Dry Bulb	Water at Surface
From San Diego, Calif., to Guadalupe Island.		
Mar. 1 4 a.	57	56
8 a.	57	58
12 m.	60	59
4 p.	59	58
8 p.	57	57
Mid.	57	58
Mar. 2 4 a.	57	58
Guadalupe Island.		
Mar. 2 8 a.	61	59
12 m.	67	60
4 p.	67	60
8 p.	64	60
Mid.	65	60
Mar. 3 4 a.	54	60
8 a.	64	60
12 m.	66	61
4 p.	64	60
8 p.	60	60
Mid.	60	60
Mar. 4 4 p.	59	60
8 a.	60	60
Making passage to San Diego, Calif.		
Mar. 4 12 m.	63	60
4 p.	60	60
8 p.	58	60
Mid.	57	58
Mar. 5 4 a.	57	58
8 a.	56	57
12 m.	61	59
4 p.	61	58
8 p.	57	57
Mid.	56	57
Mar. 6 4 a.	53	55
San Diego, Calif.		
Mar. 6 8 a.	50	57
12 m.	68	58
4 p.	62	58
8 p.	58	58
Mid.	57	58
San Diego, Calif.		
Mar. 7 4 a.	55	57
8 a.	57	58
12 m.	62	58
4 p.	60	58
8 p.	61	58
Making passage to San Benito Ids.		
Mar. 7 Mid.	60	57

Date 1911	Air: Dry Bulb	Water at Surface
Mar. 8 4 a.	59	57
8 a.	61	59
12 m.	62	60
4 p.	63	59
8 p.	60	59
Mid.	61	59
Mar. 9 4 a.	61	60
8 a.	62	60
San Benito Islands		
Mar. 9 12 m.	78	61
4 p.	75	61
8 p.	63	60
Mid.	61	60
Mar. 10 4 a.	61	60
San Benito Isl. to Cedros Isl.		
Mar. 10 8 a.	61	60
12 m.	64	60
4 p.	61	60
8 p.	58	59
Mid.	57	59
Mar. 11 4 a.	56	58
8 a.	57	59
12 m.	66	61
4 p.	67	62
8 p.	58	62
Mid.	56	60
Mar. 12 4 a.	56	60
8 a.	65	59
12 m.	85	62
4 p.	79	63
Cedros Isl. to Port San Bartolome		
Mar. 12 8 p.	60	61
Mid.	57	59
Mar. 13 4 a.	58	60
8 a.	63	60
12 m.	82	61
4 p.	78	61
8 p.	63	60
Mid.	59	59
Mar. 14 4 a.	58	60
8 a.	65	60
12 m.	83	60
4 p.	76	63
8 p.	65	60
Mar. 14 Mid.	63	59
Mar. 15 4 a.	60	59
San Bartolome to Abreojos Anchorage.		
Mar. 15 8 a.	65	59
12 m.	66	64
4 p.	67	63
8 p.	64	61
Mid.	63	62
Mar. 16 4 a.	65	62
Abreojos An. to Sta. Maria Bay		
Mar. 16 8 a.	67	61
12 m.	70	63
4 p.	69	62
8 p.	63	62
Mid.	63	61
Mar. 17 4 a.	64	63
8 a.	65	66
12 m.	70	67
4 p.	75	66
8 p.	66	66
Mid.	65	65
Mar. 18 4 a.	65	65
Sta. Maria Bay to Magdalena Bay.		
Mar. 18 8 a.	69	64
12 m.	72	65
4 p½	70	66
8 p.	65	65
Mid.	62	64
Mar. 19 4 a.	61	63
8 a.	67	64
12 m.	73	67
Mar. 19 4 p.	67	67
8 p.	65	66
Mid.	62	65
Mar. 20 4 a.	63	64
8 a.	66	68
12 m.	76	69
4 p.	70	69
8 p.	65	67
Mid.	65	65
Mar. 21. 4 a.	65	66
8 a.	65	68

Date 1911	Air: Dry Bulb	Water at Surface
Magdalena Bay to St. Lucas Bay.		
Mar. 21 12 m.	71	66
4 p.	70	65
Mid.	65	65
Mar. 22 4 a.	66	67
8 a.	66	67
12 m.	71	68
4 p.	70	68
8 p.	68	68
Mid.	68	68
Mar. 23 4 a.	67	68
8 a.	72	70
12 m.	73	70
4 p.	74	70
8 p.	72	70
Mid.	70	70
Mar. 24 4 a.	67	69
8 a.	69	69
12 m.	76	69
4 p.	71	69
8 p.	68	68
Mid.	66	67
Mar. 25 4 a.	63	68
St. Lucas Bay to San Jose del Cabo		
Mar. 25 8 a.	64	68
12 m.	72	70
4 p.	70	70
8 p.	68	69
Mid.	65	69
San Jose del Cabo to Pichilinque		
Mar. 26 4 a.	64	68
8 a.	66	68
12 m.	72	70
4 p.	70	69
8 p.	69	69
Mid.	67	70
Mar. 27 4 a.	66	69
8 a.	69	69
12 m.	72	71
4 p.	77	72
8 p.	71	72
Mid.	68	70
Mar. 28 4 a.	66	69
Mar. 28 8 a.	72	70
12 m.	76	71
4 p.	87	72
8 p.	73	71
Mid.	70	69
Mar. 29 4 a.	67	69
8 a.	75	70
12 m.	79	71
4 p.	80	72
8 p.	74	71
Mid.	71	70
Mar. 30 4 a.	68	70
8 a.	73	71
Pichilinque to Amortajada Bay		
Mar. 30 12 m.	84	74
4 p.	79	73
8 p.	74	71
Mid.	74	70
Mar. 31 4 a.	73	69
8 a.	78	71
12 m.	76	72
4 p.	80	71
8 p.	73	71
Mid.	70	70
Apr. 1 4 a.	70	70
Amortajada Bay to Agua Verde Bay		
Apr. 1 8 a.	74	70
12 m.	75	71
4 p.	81	72
8 p.	77	71
Mid.	76	70
Apr. 2 4 a.	70	69
8 a.	70	68
Agua Verde Bay to Salinas Bay		
Apr. 2 12 m.	72	68
4 p.	79	71
8 p.	66	70
Mid.	64	68
Apr. 3 4 a.	63	66
Salinas Bay to Mulege Anchorage		
Apr. 3 8 a.	68	68
12 m.	71	69

Date 1911	Air: Dry Bulb	Water at Surface
Apr. 3 4 p.	73	69
8 p.	67	67
Mid.	65	67
Apr. 4 4 a.	65	67
8 a.	70	66
12 m.	70	68
4 p.	72	68
8 p.	67	68
Mid.	64	67
Apr. 5 4 a.	63	67
Mulege Anc. to Concepcion Bay		
Apr. 5 8 a.	67	67
12 m.	77	74
4 p.	82	74
8 p.	73	72
Mid.	71	72
Apr. 6 4 a.	69	72
8 a.	80	72
12 m.	82	77
4 p.	84	76
8 p.	75	74
Mid.	73	73
Concepcion Bay		
Apr. 7 4 a.	71	72
8 a.	76	72
12 m.	76	73
4 p.	75	73
8 p.	73	73
Mid.	70	72
Apr. 8 4 a.	68	72
8 a.	77	72
12 m.	74	73
Concepcion Bay via Mulege anchorage to San Francisquito.		
Apr. 8 4 p.	73	70
8 p.	70	70
Mid.	69	68
Apr. 9 4 a.	68	67
8 a.	69	64
12 m.	70	62
4 p.	70	61
8 p.	66	60
Mid.	67	59
Apr. 10 4 a.	66	59
San Francisquito to Angel de la Guardia Id.		
Apr. 10 8 a.	69	61
12 m.	65	61
4 p.	72	62
8 p.	65	68
Mid.	63	61
Apr. 11 4 a.	61	60
8 a.	65	60
Angel de la Guardia to Tiburon		
Apr. 11 12 m.	72	64
4 p.	73	63
8 p.	65	62
Mid.	62	63
Apr. 12 4 a.	72	60
8 a.	69	61
12 m.	75	64
4 p.	79	62
8 p.	69	63
Mid.	63	62
Apr. 13 4 a.	57	60
8 a.	63	60
Tiburon Id. to San Esteban Id.		
Apr. 13 12 m.	67	62
4 p.	73	58
8 p.	66	61
Mid.	67	59
Apr. 14 4 a.	68	57
8 a.	70	58
San Esteban Id. to Guaymas		
Apr. 14 12 m.	67	63
4 p.	66	63
8 p.	67	62
Mid.	67	62
Apr. 15 4 a.	70	64
8 a.	73	64
12 m.	83	64
4 p.	80	66
Guaymas to Sta. Catalina Island.		
Apr. 15 8 p.	68	63

Date 1911	Air: Dry Bulb	Water at Surface
Apr. 15 Mid.	69	68
Apr. 16 4 a.	69	68
8 a.	72	68
Sta. Catalina Id. via. Sta. Cruz, Pichilinque.		
Apr. 16 12 m.	77	69
4 p.	73	71
8 p.	73	72
Mid.	75	72
Apr. 17 4 a.	73	72
8 a.	75	73
12 m.	83	74
4 p.	86	75
8 p.	75	73
Mid.	71	72
Apr. 18 4 a.	70	73
8 a.	73	75
12 m.	83	75
4 p.	87	74
8 p.	75	73
Mid.	69	71
Pichilinque		
Apr. 19 4 a.	67	72
Via Espiritu Santo & Caralbo Islands.		
Apr. 19 8 a.	73	71
12 m.	84	74
4 p.	78	75
8 p.	74	74
Mid.	73	74
Apr. 20 4 a.	72	69
San Jose del Cabo to Port San Bartolome.		
Apr. 20 8 a.	74	74
12 m.	72	74
4 p.	68	70
8 p.	67	66
Mid.	65	68
Apr. 21 4 a.	62	64
8 a.	67	67
12 m.	72	68
Apr. 21 4 p.	66	68
8 p.	63	65
Mid.	60	63
Apr. 22 4 a.	60	62
8 a.	60	61
12 m.	61	62
4 p.	61	61
8 p.	57	58
Mid.	57	58
Apr. 23 4 a.	55	54
8 a.	57	56
Port San Bartolome to San Francisco.		
Apr. 23 12 m.	61	60
4 p.	61	60
8 p.	59	60
Mid.	59	60
Apr. 24 4 a.	58	59
8 a.	58	58
12 m.	60	58
4 p.	59	60
8 p.	58	60
Mid.	58	59
Apr. 25 4 a.	57	58
8 a.	58	59
12 m.	58	59
4 p.	58	59
8 p.	56	58
Apr. 26 4 a.	55	56
8 a.	54	54
12 m.	61	56
4 p.	55	56
8 p.	53	54
Mid.	51	54
Apr. 27 4 a.	51	54
8 a.	53	53
12 m.	56	53
4 p.	52	53
8 p.	51	52
Mid.	50	50
Apr. 28 4 a.	49	52
8 a.	50	51

Appendix C.

Abbreviations and Symbols.

12′ Agz	12-foot Agassiz beam trawl. This was the only kind of trawl used this cruise. The runners stand 4 ft. in height and the usual type of net carries a taut headline, making the full opening available. The "reversible" style of this net, for deep-sea work where the possibility of upsetting the frame is great, was not used.
botm	bottom.
Bt. dredge	boat dredge; made of $\frac{1}{2}$-inch webbing, with a bobbinet lining; protected by a canvas apron. Towed by steam launch when used.
C. S.	Coast Survey.
D	dredging, or collecting, station.
dip	ordinary dip net on a 12-inch or 14-inch ring, with bamboo handle; used extensively in reef fishing with dynamite, and from the gangway ladder with electric light.
dyn	dynamite.
e. l	electric light.
H	hydrographic station.
H. O.	U. S. Hydrographic Office.
hbr	harbor.
K. 1	a small plankton or Kofoid net, made of No. 12 silk, on a 14-inch ring.
K. 3	same as above, but made of No. 2 silk.
Lt	light.
Luc. sdr	Lucas sounding machine.
m. b.	mud bag. This is a bag made of canvas, and sewed to an iron frame. It is about 3 feet long and 18 inches wide. It is attached at the tail of the dredge net.
wng. b	wing bag. This is a circular bag, about 3 feet long, fastened to a 14-inch brass ring; usually placed at both ends of the trawl, but one was used several times this cruise at the tail of the dredge net, instead of the square mud bag.
spec	specimen.
$3\frac{1}{2}'$ Tnr	$3\frac{1}{2}'$ Tanner beam trawl; was used from steam launch at various places when ship was at anchor.
Tnr.-Blish sdr.	Tanner-Blish sounding machine.
therm	Negretti-Zambra deep-sea thermometer, used with Tanner case.
wat. bot	water bottle. A water bottle was used at each sounding.
Hand leadline	this is used from the bow of the ship when approaching an anchorage, or from a small boat to make soundings in proximity of the anchorage.
‡	signifies nets towed astern, from taffrail, side by side.

"Character of bottom," determined by the specimens from the sounding cup, is expressed by abbreviations, the key to which is appended. It will be noted that these abbreviations are arbitrarily capitalized for nouns. When used as adjectives, however, the noun abbreviations are not capitalized.

bk	black
bl	blue
br	brown
br-gn	brownish-green
brk	broken
C.	Clay
Clmps	Clumps
Co.	Coral
crs.	coarse
dk	dark
fne	fine
For	Foraminifera
G	Gravel
Glob.	Globigerina
gn.	green
gn-br	greenish-brown
gn-gy	greenish-gray
gy	gray
hrd	hard
Lav.	Lava
M	Mud
mrgn	marginal
Mss	Masses
Oz	Ooze
P.	Pebbles
Ptr	Pteropod
R	Rock
Rf.	Reef
rky	rocky
S	Sand
sctrd	scattered
Sh.	shells
sml	small
Sp.	Specks
St.	Stones
vol	volcanic
W	Seaweed
wh	white

Appendix C.

DREDGING AND HYDROGRAPHIC RECORDS OF THE U. S. FISHERIES STEA

Station No.	Position	Chart	Date	Time	De
	Between San Diego, Cal. and Guadalupe Island, Mexico.				
D. 5673	Near U. S. Mex. Boundary 3782′ Cone– 32 18′ 30″N. 116 46′ 00″W. bore N.42 E.	H.O. 1006 (1887)	Mar. 1	6:23 A.M. 8:23 A.M.	10 . . .
	4900′ Cone– 31 36′ 30″N., 116 14′ 30″W. bore N.82 E. 31 26′ 00″N. 117 42′ 00″W.				
	Guadalupe Island, East Coast, Northern End.	see below	Mar. 2	9:00 A.M.	. . .
H. 4938	Black Rock, N.89 W. Near North Pt., 1.5 mi. 29 10′ 20″N., 118 15′ 45″ W.	H.O. 1681 (1897)	Mar. 2	6:55 A.M.	3
H. 4939	Near North Point, N.12 E. Block House S.78 W. 29 08′ 50″N., 118 17′ 50″W.	"	"	7:55 A.M.	2
H. 4940	Elephant Rock, S.23 W. Cone N side of Id. S.71 E. 29 09′ 30″ N., 118 23′ 00″ W.	"	"	9:10 A.M.	1
H. 4941	E. R., S.18 W., Cone N side of Id., N.75 E. 29 09′ 00″N., 118 23′ 20″W.	"	"	9:25 A.M.	
H. 4942	E. R., S.1 W., Cone N side of Id., N.65 E. 29 08′ 40″N., 118 24′ 10″W.	"	"	9:50 A.M.	
H. 4943	E. R., S.40 E., Cone N side of Id., N.60 E. 29 08′ 00″N., 118 24′ 30″W.	"	"	10:05 A.M.	
H. 4944	E. R., N.46 E., Rock at Str. Pt., S.11 E. 29 06′ 50″N., 118 25′ 00″W.	"	"	10:25 A.M.	
H. 4945	E. R., N.17 E., Rock at Str. Pt., S.7 E. 29 00′ 20″N., 118 24′ 30″ W.	"	"	11:00 A.M.	
H. 4946	Midway bet. pts. at E. R. & Str. Pts. 29 04′ 50″N., 118 24′ 00″W.	"	"	11:30 A.M. to 2:00 P.M.	25-
	"	"	Mar. 3	7:45 P.M.	. . .
H. 4947	Rock at Str. Pt. & right tangent Inner Id. in line S.21 E.; E. R., N.6 E.; 29 00′ 30″N. 118 24′ 30″W.	"	Mar. 4	4:08 P.M.	
H. 4948	Rock at S. Pt. & E. R. in line N.2 W. Inner Id. rt. tan. S.22 E., 28 59′ 30″N., 118 25′ 50″ W.	"	"	4:12 P.M.	
H. 4949	S. Pt. & E. R. in line N.4 W. Inner Id. rt. tan. S.21 E.; 29 01′ 15″N., 118 23′ 00″W.	"	"	4:20 P.M.	
H. 4950	Str. Pt. N.26 W. Inner Id. rt. tan. S.21 E. 29 01′ 15″N., 118 22′ 50″W.	"	"	4:43 P.M.	

P ‘ALBATROSS’ DURING THE VOYAGE TO THE GULF OF CALIFORNIA IN 1911.

racter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Surface	Botm.						
y M; few Glob.	56.	56	......	Luc. sdr.	botm.	:28	N.E.	0.2	Thermo did not capsize.
....	58.	58	......	12′ Agz;m.b.	....	.....	....	....	One bridle-stop parted.
....	...	....	......	dyn.	15 ft.	4:	....	....	4 shots.
ottom not reached	....	....	... ..	Tnr.-Blish sdr.	....	.....	....	....	Hand line fishing from ship at various times with from 2 to 8 lines when at anchor.
.	....	....	....	“					
....	....	....	......	“					
l. S.	....	...	.....	“					
	...	....	......	“					
	....	....	.....	“					
; St.	...	...	......	“					
s. S.	....	...	....	“					
	....	..	......	Hand lead line					
	....	....	......	e.l. dip.	Surf.	3:	....	....	6 shots of 1 to 3 dyn. caps at gangway.
	....	....	......	Tnr.-Blish sdr.					
ottom not reached	....	....	.....	“					
y S.	....	....	......	“					
	....	....	......	“					

Appendix C.

DREDGING AND HYDROGRAPHIC RECORDS OF THE U. S. FISHERIES STEAMSHIP 'ALBATROSS' DURING THE VOYAGE TO THE GULF OF CALIFORNIA IN 1911.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
	Between San Diego, Cal. and Guadalupe Island, Mexico.														
D. 5673	Near U. S. Mex. Boundary	H.O. 1006 (1887)	Mar. 1	6:23 A.M.	1090	bl.g y M; few Glob.	56.	56	......	Luc. sdr.	botm.	:28	N.E.	0.2	Thermo did not capsize.
	3782′ Cone– 32 18′ 30″N. 116 46′ 00″W. bore N.42 E.			8:23 A.M.	......	....	58.	58	......	12′ Agz;m.b.	....	.....	....	....	One bridle-stop parted.
	4900′ Cone– 31 36′ 30″N., 116 14′ 30″W. bore N.82 E.														
	31 26′ 00″N. 117 42′ 00″W.														
	Guadalupe Island, East Coast, Northern End.	see below	Mar. 2	9:00 A.M.	......	....	...	....	......	dyn.	15 ft.	4:	....	....	4 shots.
H. 4938	Black Rock, N.89 W. Near North Pt., 1.5 mi. 29 10′ 20″N., 118 15′ 45″ W.	H.O. 1681 (1897)	Mar. 2	6:55 A.M.	300	bottom not reached	....	....	....	Tnr.-Blish sdr.	....	.....	....	....	Hand line fishing from ship at various times with from 2 to 8 lines when at anchor.
H. 4939	Near North Point, N.12 E. Block House S.78 W. 29 08′ 50″N., 118 17′ 50″W.	"	"	7:55 A.M.	290	hrd.	....	....	....	"					
H. 4940	Elephant Rock, S.23 W. Cone N side of Id. S.71 E. 29 09′ 30″ N., 118 23′ 00″ W.	"	"	9:10 A.M.	110	....	....	....	......	"					
H. 4941	E. R., S.18 W., Cone N side of Id., N.75 E. 29 09′ 00″N., 118 23′ 20″W.	"	"	9:25 A.M.	30	crs bl. S.	....	....	.....	"					
H. 4942	E. R., S.1 W., Cone N side of Id., N.65 E. 29 08′ 40″N., 118 24′ 10″W.	"	"	9:50 A.M.	27	"	...	....	......	"					
H. 4943	E. R., S.40 E., Cone N side of Id., N.60 E. 29 08′ 00″N., 118 24′ 30″W.	"	"	10:05 A.M.	31	"	....	....	.....	"					
H. 4944	E. R., N.46 E., Rock at Str. Pt., S.11 E. 29 06′ 50″N., 118 25′ 00″W.	"	"	10:25 A.M.	58	g y S; St.	...	...	......	"					
H. 4945	E. R., N.17 E., Rock at Str. Pt., S.7 E. 29 00′ 20″N., 118 24′ 30″ W.	"	"	11:00 A.M.	42	bl. crs. S.	....	...	....	"					
H. 4946	Midway bet. pts. at E. R. & Str. Pts. 29 04′ 50″N., 118 24′ 00″W.	"	"	11:30 A.M. to 2:00 P.M.	25–12	"	....	..	......	Hand lead line					
	"	"	Mar. 3	7:45 P.M.	......	"	....	....	......	e.l. dip.	Surf.	3:	....	....	6 shots of 1 to 3 dyn. caps at gangway.
H. 4947	Rock at Str. Pt. & right tangent Inner Id. in line S.21 E.; E. R., N.6 E.; 29 00′ 30″N. 118 24′ 30″W.	"	Mar. 4	4:08 P.M.	89	hrd.	....	....	......	Tnr.-Blish sdr.					
H. 4948	Rock at S. Pt. & E. R. in line N.2 W. Inner Id. rt. tan. S.22 E., 28 59′ 30″N., 118 25′ 50″ W.	"	"	4:12 P.M.	250	bottom not reached	....	....	.....	"					
H. 4949	S. Pt. & E. R. in line N.4 W. Inner Id. rt. tan. S.21 E.; 29 01′ 15″N., 118 23′ 00″W.	"	"	4:20 P.M.	226	fne gy S.	....	....	......	"					
H. 4950	Str. Pt. N.26 W. Inner Id. rt. tan. S.21 E. 29 01′ 15″N., 118 22′ 50″W.	"	"	4:43 P.M.	138	"	....	....	......	"					

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	D
	Between Guadalupe Island, Mexico, & San Diego, Cal. Straight run.				
	Between San Diego, Cal., & San Benito Is., Mexico.				
H. 4951	3782′ Cone, N.22 E. Bluff Peak (1450′) N. 78 E., 31° 28′ 45″N., 117° 09′ 50″W.	H.O. 1149 (1909)	Mar. 8	6:11 A.M	
D. 5674	"	"	"	6:11–7:50A.M.	
	Middle San Benito Id. So. side (anch.) S. E. Pt., W. San Benito Id. S.62°W., NE. Pt. N.34°W.	H.O. 1194 (1890)	Mar. 9	8:30 A.M. 9:00 A.M. 7:30 P.M.	
	San Benito Islands to Cedros Is., off Lower Cal. Straight run.				
	Cedros Island South Bay (anch)				
	Prominent Blk Rock N.58°W., Rock ½ mi. E. of latter N.19°E.	H.O. 1192 (1890)	Mar. 10	9:00 A.M.	
	So. part of E. side (anch) E. tan. Cedros Id. N.26°E., Morro Redondo Pt. S.5°W.	H.O. 1310 (1909)	Mar. 11	10:30 A.M. 2:00 P.M. 8:30 P.M.	. . . . . .
	Middle of E. side (anch) E. of 1808′ Peak. Lat. 28° 13′ 00″N.	"	Mar. 12	9:00 A.M. 9:30 A.M. 2:30 P.M.	. . . .
	Cedros Is. to Port San Bartolome, Lower Cal. Straight run.				
	Port San Bartolome (anch) Coffin Rock S'n. tan. S.65°W. Entrance Rock, N.68°W.	H.O. 1204 (1890)	Mar. 13	9:00 A.M. 10:30 A.M.	. . . .
	"	"	Mar. 14	8:30 A.M. 9:30 A.M. 8:00 P.M.	. . . . . .
	Port San Bartolome to San Cristobal Bay, Lower Cal. Straight run.				
	San Cris. Bay (anch) Morro Hermoso Pt. N.59°W.; San Pablo Bluff, S.10°E.	H.O. 1310 (1909)	Mar. 15	10:00 A.M.	
	San Cristobal Bay to San Roque Island, Lower Cal.				
D. 5675	Lower Cal., Mex., San Pablo Pt. N.33°E.; Asuncion Pt. N.87°E. (27° 07′ 08″ N.114° 33′ 10″W.)	H.O. 1310 (1909)	"	2:11 P.M. 2:50 P.M.	 . .
	San Roque Is. (anch) NE. end of Is., S.68°E., W. end of Is. S.10°W.	H.O. 1268 (1891)	"	5:00 P.M.	. .

acter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Sur-face	Botm.						
I; fne S: ob.	60°	58°	39.4°	Luc. sdr.	....	.....	....	....	Propeller on water-bottle jammed.
"	60°	58°	39.4°	"					
	61°	59°	......	12'Agz; m.b.	botm.	:25	N.49°W.	2.4	
....	....	....	......	18 handlines	botm.	8:00			
. R.	...	...	......	100' seine	5–15ft.	2:30	....	....	7 hauls on beach of W. San Benito Id.
....	....	....	......	e.l; dip.	....	1:00			
....	....	....	......	6 handlines	botm.	3:	....	....	Seining party failed to find suitable beach.
....	....	....	......	100' seine	10 ft.	1:00	....	....	3 hauls on beach near anchorage.
....	....	....	......	200' seine	20 ft.	3:00	....	....	
....	....	....	......	e.l. dip.	surf.	1:00	....	...	"
. G.	...	....	......	100'seine	10'	2:00	....	....	2 " } 30 min. each
....	....	....	......	3½' Tn'e	botm.	2:30	....	....	5 "
....	....	....	......	Bt. dredge	"	1:00	....	....	2 "
. G.	....	....	......	130' seine	5 ft.	4:00	....	....	9 hauls, SE. beach near anchorage.
....	....	....	......	Bt. dredge	botm.	3:00	....	....	12 hauls,5-30 mi. ea.
	....	....	......	130' seine	4'	7:00	....	....	14 " SE. beach
....	....	....	......	Bt. dredge	botm.	3:30	....	....	7 " 10-30 mi. ea.
....	....	....	......	e.l. dip.	surf.	1:00	....	....	Handlines used from time to time while at anchor.
....	...	....	......	8 handlines	botm.	1:00	....	....	Anchored 1½ hrs. while party made observations along shore for elephant seals.
I.fne S.	67°	64°	44.6°	Luc.sdr.					
....	67°	63°	......	12' Agz;m.b.	botm.	0:20	S.50°W	0.7	
....	....	....	......	....	....	....	....	....	anchored 2½ hrs. shore party only.

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Sur-face	Botm.						
	Between Guadalupe Island, Mexico, & San Diego, Cal. Straight run.														
	Between San Diego, Cal., & San Benito Is., Mexico.														
H. 4951	3782′ Cone, N.22 E. Bluff Peak (1450′) N. 78 E., 31° 28′ 45″N., 117° 09′ 50″W.	H.O. 1149 (1909)	Mar. 8	6:11 A.M	590	gn. M; fne S: Glob.	60°	58°	39.4°	Luc. sdr.	....	.....	....	....	Propeller on water-bottle jammed.
D. 5674	“	“	“	6:11–7:50A.M.	590	“	60°	58°	39.4°	“					
							61°	59°	......	12′Agz; m.b.	botm.	:25	N.49°W.	2.4	
				8:30 A.M.	13	....	....	....	......	18 handlines	botm.	8:00			
	Middle San Benito Id. So. side (anch.) S. E. Pt., W. San Benito Id. S.62°W., NE. Pt. N.34°W.	H.O. 1194 (1890)	Mar. 9	9:00 A.M.	—	S. G. R.	...	...	......	100′ seine	5–15ft.	2:30	....	....	7 hauls on beach of W. San Benito Id.
				7:30 P.M.	13	....	....	....	......	e.l; dip.	....	1:00			
	San Benito Islands to Cedros Is., off Lower Cal. Straight run.														
	Cedros Island South Bay (anch)														
	Prominent Blk Rock N.58°W., Rock ½ mi. E. of latter N.19°E.	H.O. 1192 (1890)	Mar. 10	9:00 A.M.	17	....	....	....	......	6 handlines	botm.	3:	....	....	Seining party failed to find suitable beach.
	So. part of E. side (anch) E. tan. Cedros Id. N.26°E., Morro Redondo Pt. S.5°W.	H.O. 1310 (1909)	Mar. 11	10:30 A.M.	......	....	....	....	......	100′ seine	10 ft.	1:00	....	....	3 hauls on beach near anchorage.
				2:00 P.M.	......	....	....	....	......	200′ seine	20 ft.	3:00	....	....	
				8:30 P.M.	......	....	....	....	......	e.l. dip.	surf.	1:00	....	..	“
	Middle of E. side (anch) E. of 1808′ Peak. Lat. 28° 13′ 00″N.	“	Mar. 12	9:00 A.M.	......	S. R. G.	...	....	......	100′seine	10′	2:00	....	....	2 “
				9:30 A.M.	......	....	....	....	......	3½′ Tn’e	botm.	2:30	....	....	5 “ } 30 min. each
				2:30 P.M.	......	....	....	....	......	Bt. dredge	“	1:00	....	....	2 “
	Cedros Is. to Port San Bartolome, Lower Cal. Straight run.														
	Port San Bartolome (anch) Coffin Rock S’n. tan. S.65°W. Entrance Rock, N.68°W.	H.O. 1204 (1890)	Mar. 13	9:00 A.M.	......	M. S. G.	....	....	......	130′ seine	5 ft.	4:00	....	....	9 hauls, SE. beach near anchorage.
				10:30 A.M.	......	....	....	...	......	Bt. dredge	botm.	3:00	....	....	12 hauls,5-30 mi. ea.
	“	“	Mar. 14	8:30 A.M.	......	“	....	....	......	130′ seine	4′	7:00	....	....	14 “ SE. beach
				9:30 A.M.	......	....	....	...	......	Bt. dredge	botm.	3:30	....	....	7 “ 10-30 mi. ea.
				8:00 P.M.	......	....	....	....	......	e.l. dip.	surf.	1:00	....	....	Handlines used from time to time while at anchor.
	Port San Bartolome to San Cristobal Bay, Lower Cal. Straight run.														
	San Cris. Bay (anch) Morro Hermoso Pt. N.59°W.; San Pablo Bluff, S.10°E.	H.O. 1310 (1909)	Mar. 15	10:00 A.M.	7	....	...	....	......	8 handlines	botm.	1:00	....	....	Anchored 1½ hrs. while party made observations along shore for elephant seals.
	San Cristobal Bay to San Roque Island, Lower Cal.														
D. 5675	Lower Cal., Mex., San Pablo Pt. N.33°E.; Asuncion Pt. N.87°E. (27° 07′ 08″ N.114° 33′ 10″W.)	H.O. 1310 (1909)	“	2:11 P.M.	284	gn.M.fne S.	67°	64°	44.6°	Luc.sdr.					
				2:50 P.M.	......	....	67°	63°	......	12′ Agz;m.b.	botm.	0:20	S.50°W	0.7	
	San Roque Is. (anch) NE. end of Is., S.68°E., W. end of Is. S.10°W.	H.O. 1268 (1891)	“	5:00 P.M.	......	....	....	....	......	....	....	....	....	....	anchored 2½ hrs. shore party only.

Appendix C — Continned.

Station No.	Position	Chart	Date	Time	Dep F
	San Roque Id. to Abreojos Anchorage, Ballenas Bay, Lower Cal. Straight run.				
	Abreojos Anch. (anch) Abreojos Pt., S. 73°W. 312′ Hill, N.08′W.	H.O. 1294 (1891)	Mar. 16	8:30 A.M.	....
				1:30 P.M.	....
		....	....	10:00 A.M.	....
		....	....	9:00 A.M.	
	Between Ballenas Bay & Santa Maria Bay, Lower Cal.				
H. 4952	25° 31′ 15″N., 113° 29′ 30″W.	H.O. 1493 (1908)	Mar. 17	8:17 A.M.	64
D. 5676	“	“	“	8:17–9:06A.M.	64
		....	....	....	....
H. 4953	25° 23′ 45″N., 113° 16′ 00″W.	“	“	1:13 P.M.	73
D. 5677	25° 23′ 45″N., 113° 16′ 00″W.	H.O. 1493 (1908)	Mar. 17	1:13 P.M.	73
				2:05 P.M.	....
				1:40 P.M.	....
	Santa Maria Bay (anch) Hughes Pt.S.10°W. Mt. San Lazaro N.70°W.	H.O. 1636 (1898)	Mar. 18	7:30 A.M.	....
			....	10:00 A.M.	....
	Santa Maria Bay to Magdalena Bay, Lower Cal. Straight run.				
	Magdalena Bay, off Mag. (anch) Mag. Light S.88°W., Cove Pt. S.52°E.	H.O. 1636 (1898)	Mar. 18 –19	....	....
	Off N. side Santa Margarita Is. (anch) L. tan. Deering Bluff N.60°E.; NW. tan. Id. N.88°W.	“	Mar. 19	1:00 P.M.	8
	Marcy Channel (anch) Cisne Pt. S.70°W.; E. tan. Santa Margarita Id. S.46°E.	“	Mar. 20	9:30 A.M.	....
				10:00 A.M.	....
				2:00 P.M.	....
D. 5678	Sail Rock, Entrada Pt.; S.53°W.; Redondo Pt. S.15°W.(24° 35′ 20″N. 111° 59′ 35″W.)	“	Mar. 21	9:58–10:03 A.M.	13 ....
	Off Magdalena (anch) Mag. wharf S. 82°W. Cove Pt. S.57°E.	“	“	1:45 P.M.	....
				2:00 P.M.	....
	Between Magdalena Bay & San Lucas Bay, Lower Cal.				
D. 5679	23° 47′ 45″N., III° 23′ 00″W.	H.O. 1664 (1899)	Mar. 22	6:41–7:21A.M.	32
D. 5680	23° 40′ 30″N., 111° 12′ 45″W.	“	“	10:09–11:24 A.M.	38
D. 5681	23° 33′ 15″N.; 111° 02′ 10″W.	“	“	2:08–46 P.M.	40

cter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Surface	Botm.						
	....	....	......	130′ Seine	6′	3:00	....	....	3 hauls, beach near anchorage.
	...	....	......	200′ seine	10′	2:30	....	....	“
	...	....	......	Bt. dredge	botm.	3:00	....	....	7 hauls 15–20 mi. ea.
	....	....	......	8 handlines	“	3:00			
; fneS; Glob.	65°	66°	39.0°	Luc. sdr.					
“	65°	66°	39.0°	“	botm.	0:20	NWxW	0.2	
....	70°	65°	......	12′ Agz; m.b.					
“	70°	66°	38.6°	Luc. sdr.					
;fne S. Glob.	70°	66°	38.6°	Lne sdr.12′Agz;					
....	70°	66°	......	m.b. K's I&3‡	botm.	0:20	WNW	0.2	
....	70°	66°	......	....	surf.	0:50	“	....	Towed astern during dredging operation.
	....	....	......	Bt. dredge	botm.	5:00	....	....	13 hauls 10 min. each
....	....	...	......	100′ seine	8′	1:30	....	....	3 “ on N. beach
....	....	....	......	....	....	....	....	....	Stopped for inspec. of port officials.
....	....	....	......	....	....	....	....	....	Shore parties.
	....	....	......	200′ seine	10′	2:00	....	....	3 hauls on beach of Mangrove Id.
....	....	....	......	Bt. dredge	botm.	:45	....	....	4 hauls 10 mi. ea.
	....	....	......	100′ seine	5 ft.	2:30	....	....	Worked up lagoon of Mangrove Id.
....	....	....	......	....	......	....	....	....	
brk.Sh.	71°	66°	......	hand line					
dge)	71°	66°	......	12′ Agz;m.b.	botm.	:20	N81°W.	0.6	
....	....	....	......	Bt. dredge	botm.	2:00	....	....	7 hauls 5–10 mi. ea.
	....	....	......	100′seine	6′	3:00	....	....	Worked up Howland lagoon
M.For.	65°	67°	44.1°	Luc. sdr. 12′	botm.	0:16	N68°W.	0.2	Net badly torn.
	65°	67°	..	Agz;m.b.2wng.b's					
“	68°	68°	43.6°	Luc. sdr.					
	71°	68°	..	12′Agz:wng b	botm.	:21	“	“	Wing bag at tail of net.
ecm.	70°	68°	43.3°	“	“	:20	2	“	“
M;For	70°	68°	..						
dge)									

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
	San Roque Id. to Abreojos Anchorage, Ballenas Bay, Lower Cal. Straight run.														
	Abreojos Anch. (anch) Abreojos Pt., S. 73°W. 312′ Hill, N.08′W.	H.O. 1294 (1891)	Mar. 16	8:30 A.M.	......	fne S.	....	....	......	130′ Seine	6′	3:00	....	....	3 hauls, beach near anchorage.
				1:30 P.M.	......	"	....	....	......	200′ seine	10′	2:30	....	....	"
		....	....	10:00 A.M.	......	"	....	....	......	Bt. dredge	botm.	3:00	....	....	7 hauls 15–20 mi. ea.
		....	....	9:00 A.M.	6	"	....	....	......	8 handlines	"	3:00			
	Between Ballenas Bay & Santa Maria Bay, Lower Cal.														
H. 4952	25° 31′ 15″N., 113° 29′ 30″W.	H.O. 1493 (1908)	Mar. 17	8:17 A.M.	645	gn.M; fneS; Glob.	65°	66°	39.0°	Luc. sdr.					
D. 5676	"	"	"	8:17–9:06A.M.	645	"	65°	66°	39.0°	"	botm.	0:20	NWxW	0.2	
		....	....	....	......	....	70°	65°	......	12′ Agz; m.b.					
H. 4953	25° 23′ 45″N., 113° 16′ 00″W.	"	"	1:13 P.M.	735	"	70°	66°	38.6°	Luc. sdr.					
D. 5677	25° 23′ 45″N., 113° 16′ 00″W.	H.O. 1493 (1908)	Mar. 17	1:13 P.M.	735	gn.M;fne S. Glob.	70°	66°	38.6°	Lne sdr.12′Agz;					
				2:05 P.M.	......	....	70°	66°	......	m.b. K's I&3‡	botm.	0:20	WNW	0.2	
				1:40 P.M.	......	....	70°	66°	......	....	surf.	0:50	"	....	Towed astern during dredging operation.
	Santa Maria Bay (anch) Hughes Pt.S.10°W. Mt. San Lazaro N.70°W.	H.O. 1636 (1898)	Mar. 18	7:30 A.M.	......	S.	....	....	......	Bt. dredge	botm.	5:00	....	....	13 hauls 10 min. each
			....	10:00 A.M.	......	....	....	....	......	100′ seine	8′	1:30	....	....	3 " on N. beach
	Santa Maria Bay to Magdalena Bay, Lower Cal. Straight run.														
	Magdalena Bay, off Mag. (anch) Mag. Light S.88°W., Cove Pt. S.52°E.	H.O. 1636 (1898)	Mar. 18 –19	....	......	....	....	....	......	....	....	....	....	....	Stopped for inspec. of port officials.
	Off N. side Santa Margarita Is. (anch) L. tan. Deering Bluff N.60°E.; NW. tan. Id. N.88°W.	"	Mar. 19	1:00 P.M.	8½	....	....	....	......	....	....	....	....	....	Shore parties.
	Marcy Channel (anch) Cisne Pt. S.70°W.; E. tan. Santa Margarita Id. S.46°E.	"	Mar. 20	9:30 A.M.	......	S.	....	....	......	200′ seine	10′	2:00	....	....	3 hauls on beach of Mangrove Id.
				10:00 A.M.	......	....	....	....	......	Bt. dredge	botm.	:45	....	....	4 hauls 10 mi. ea.
				2:00 P.M.	......	M.	....	....	......	100′ seine	5 ft.	2:30	....	....	Worked up lagoon of Mangrove Id.
						....	....	....	......	....	....	....	....	....	
D. 5678	Sail Rock, Entrada Pt.; S.53°W.; Redondo Pt. S.15°W.(24° 35′ 20″N. 111° 59′ 35″W.)	"	Mar. 21	9:58–10:03 A.M.	13½	S. few brk.Sh.	71°	66°	......	hand line					
					......	(dredge)	71°	66°	......	12′ Agz;m.b.	botm.	:20	N81°W.	0.6	
	Off Magdalena (anch) Mag. wharf S. 82°W. Cove Pt. S.57°E.	"	°"	1:45 P.M.	......	....	....	....	......	Bt. dredge	botm.	2:00	....	....	7 hauls 5–10 mi. ea.
				2:00 P.M.	......	M.	....	....	......	100′seine	6′	3:00	....	....	Worked up Howland lagoon
	Between Magdalena Bay & San Lucas Bay, Lower Cal.														
D. 5679	23° 47′ 45″N., III° 23′ 00″W.	H.O. 1664 (1899)	Mar. 22	6:41–7:21A.M.	325	dk gn.M.For.	65°	67°	44.1°	Luc. sdr. 12′	botm.	0:16	N68°W.	0.2	Net badly torn.
							65°	67°	. .	Agz;m.b.2wng.b's					
D. 5680	23° 40′ 30″N., 111° 12′ 45″W.	"	"	10:09–11:24 A.M.	389	"	68°	68°	43.6°	Luc. sdr.					
							71°	68°	. .	12′Agz:wng b	botm.	:21	"	"	Wing bag at tail of net.
D. 5681	23° 33′ 15″N.; 111° 02′ 10″W.	"	"	2:08–46 P.M.	405	No specm.	70°	68°	43.3°	"	"	:20	2	"	"
						dkgn.M;For (dredge)	70°	68°	. .						

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	De
	San Lucas Bay & Vicinity				
D. 5681	S. L. Bay (anch) Cape St. L. S.70°E.; Customs House N.77°W.	H.O. 1666 (1898)	Mar. 23	8:30 A.M.	. .
				2:00 P.M.	. .
				9:30 A.M.	. .
				8:00 P.M.	
D. 5682	Off St. L. Bay; Cabo Falso N.61°W. Cape St. Lucas, N.11°W. (22° 48′ 20″N., 109° 52′ 40″W.	“	Mar. 24	7:32–8:18A.M.	.
	St. L. Bay (anch) Cape St. L. S.3°W.; Customs House S.88°W.	“	“	1:30–7:45P.M.	. .
	San Lucas Bay to San Jose del Cabo Bay, Lower Cal. Straight run.				
	S. J. del C. Bay (anch) Semaphore S.83°W. Customs house, N.42°W.	H.O. 1667 (1898)	Mar. 25	. . . .	. .
			Mar. 26	9:30 A.M.	. .
	Gulf of Cal. (Western side).				
	Pichilinque Harbor (anch) SE. tan. San Juan Is. S.14°W.; SW. tan. N. side of False Bay, S.41°E.	H.O. 2087 (1902)	Mar. 27	7:00 P.M.	
			Mar. 28	“	
			Mar. 29	“	
	Amortajada Bay, San Josef Id. (anch) S. tan. Cayo Id., S.81°W.; Coyote Id. S. 12°E.	H.O. 2181 (1904)	Mar. 30	7:00 P.M.	
			Mar. 31	8:30 A.M.	. .
				9:00 A.M.	. .
				1:30 P.M.	. .
				1:30 P.M.	. .
	Agua Verde Bay (anch) San Pasqual Pt., N.10°W.; Opposite Pt. N.83°E.	H.O. 850 (1878)	Apr. 1	4:00 P.M.	. .
			. . . .	7:30 P.M.	
		. . . .	Apr. 2	8:30 A.M.	. .
		. . . .	. . . .	8:45 A.M.	. .
		. . . .	. . . .	8:15 A.M.	. .
	Salinas Bay, Carmen Id. (anch) Perice Pt., S.63°E.; White Pt. S.29°W.	H.O. 2181 (1904)	Apr. 2	7:00 P.M.	
			Apr. 3	8:00 A.M.	. .
		. . . .	“	8:00 A.M.	. .
				9:00 A.M.	.
	Mulege Anchorage, Mouth of Conception Bay (anch). Sombrerito Pt. S.44°W.; Gallite Pt. S.54°E.	H.O. 849 (1878)	Apr. 4	8:00 A.M.	. .
				1:00 P.M.	.

acter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Surface	Botm.						
.	....	....	......	175′ seine	10–20′	3:00	....	....	5 hauls, beach S. of village.
	....	....	......	200′ “	20–30′	2:30	....	....	2 hauls, beach S. of village.
....	....	....	......	Bt. dredge	botm.	3:00	....	....	13 hauls, 10–15 mi. ea.
....	....	....	......	e.l. dip.	surf.	1:30			
	69	69	40.8	Luc.sdr.					
....	69	69	......	12′ Agz;wng. b.	botm.	:20	S18°W.	0.6	Wing bag at tail of net.
	....	....	......	100′ seine	10–15′	3:00	....	....	6 hauls beach S. of village.
....	....	....	......	e.l.;dip.	surf.	2:15			
....	....	....	......	....	....	.....	....	....	Shore parties.
.	....	....	......	16′ seine	3′	4:00	....	....	A number of hauls in streams & small lagoons.
....	....	....	......	e.l. dip.	surf.	3:00			
....	....	....	......	“	“	2:00			
....	....	....	......	“	“	3:00			
....	....	....	......	e.l.,dip.	surf.	2:00			
	....	....	......	175′ seine	10–20′	3:00	....	....	5 hauls beach near mouth of San José River.
....	....	....	......	Bt. dredge	botm.	1:30	....	....	4 hauls of 10 mi. ea.
	....	....	......	100′ seine	5′	3:30	....	....	Working up S. José River.
....	....	....	......	dyn.	15–25′	4:00	....	....	6 shots.
.	....	....	......	175′ seine	10–15′	1:30	....	....	3 hauls, main beach.
....	....	....	......	e.l.; dip.	surf.	2:45			2 small ponds close to beach.
	....	....	......	16′ seine	3′	1:00			
.	....	....	......	175′ seine	10–15′	1:30			3 hauls, main beach.
....	....	....	......	Bt, dredge	botm.	2:30			12 hauls 10 to 20 mi. ea.
....	....	....	......	e.l.; dip.	surf.	2:00			
.	....	....	......	175′ seine	10′	3:15	....	....	6 hauls NW. beach.
....	....	....	......	dyn.	8–18′	3:15	....	....	6 shots.
....	....	....	......	3½′ Tne.	botm.	2:15	....	....	6 hauls 20 mi. ea.
....	....	....	......	Bt. dredge	“	3:30	....	....	14 hauls varying time.
....	....	....	......	dyn.	6–8′	1:00	....	....	2 shots, 1 shot lost.

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
	San Lucas Bay & Vicinity														
D. 5681	S. L. Bay (anch) Cape St. L. S.70°E.; Customs House N.77°W.	H.O. 1666 (1898)	Mar. 23	8:30 A.M.	......	crs. S.	....	....	......	175′ seine	10–20′	3:00	....	....	5 hauls, beach S. of village.
				2:00 P.M.	......	"	....	....	......	200′ "	20–30′	2:30	....	....	2 hauls, beach S. of village.
				9:30 A.M.	......	....	....	....	......	Bt. dredge	botm.	3:00	....	....	13 hauls, 10–15 mi. ea.
				8:00 P.M.	13½	....	....	....	......	e.l. dip.	surf.	1:30			
D. 5682	Off St. L. Bay; Cabo Falso N.61°W. Cape St. Lucas, N.11°W. (22° 48′ 20″N., 109° 52′ 40″W.	"	Mar. 24	7:32–8:18A.M.	491	S.	69	69	40.8	Luc.sdr.					
						....	69	69	......	12′ Agz;wng. b.	botm.	:20	S18°W.	0.6	Wing bag at tail of net.
	St. L. Bay (anch) Cape St. L. S.3°W.; Cus-	"	"	1:30–7:45P.M.	......	S.	....	....	......	100′ seine	10–15′	3:00	....	....	6 hauls beach S. of village.
	toms House S.88°W.				11	....	....	....	......	e.l.;dip.	surf.	2:15			
	San Lucas Bay to San Jose del Cabo Bay, Lower Cal. Straight run.														
	S. J. del C. Bay (anch) Semaphore S.83°W. Customs house, N.42°W.	H.O. 1667 (1898)	Mar. 25	....	......	....	....	....	......	....	......	.....	....	....	Shore parties.
			Mar. 26	9:30 A.M.	......	M. S.	....	....	......	16′ seine	3′	4:00	....	....	A number of hauls in streams & small lagoons.
	Gulf of Cal. (Western side).														
	Pichilinque Harbor (anch) SE. tan. San Juan Is. S.14°W.; SW. tan. N. side of False Bay, S.41°E.	H.O. 2087 (1902)	Mar. 27	7:00 P.M.	5¼	....	....	....	......	e.l. dip.	surf.	3:00			
			Mar. 28	"	"	....	....	....	......	"	"	2:00			
			Mar. 29	"	"	....	....	....	......	"	"	3:00			
	Amortajada Bay, San Josef Id. (anch) S. tan. Cayo Id., S.81°W.; Coyote Id. S. 12°E.	H.O. 2181 (1904)	Mar. 30	7:00 P.M.	11½	....	....	....	......	e.l.,dip.	surf.	2:00			
			Mar. 31	8:30 A.M.	......	S.	....	....	......	175′ seine	10–20′	3:00	....	....	5 hauls beach near mouth of San José River.
				9:00 A.M.	......	....	....	....	......	Bt. dredge	botm.	1:30	....	....	4 hauls of 10 mi. ea.
				1:30 P.M.	......	S.	....	....	......	100′ seine	5′	3:30	....	....	Working up S. José River.
				1:30 P.M.	......	....	....	....	......	dyn.	15–25′	4:00	....	....	6 shots.
	Agua Verde Bay (anch) San Pasqual Pt., N.10°W.; Opposite Pt. N.83°E.	H.O. 850 (1878)	Apr. 1	4:00 P.M.	......	fine S.	....	....	......	175′ seine	10–15′	1:30	....	....	3 hauls, main beach.
			....	7:30 P.M.	13	....	....	....	......	e.l.; dip.	surf.	2:45	·	·	2 small ponds close to beach.
		....	Apr. 2	8:30 A.M.	......	M.	....	....	......	16′ seine	3′	1:00			
		....	....	8:45 A.M.	......	fine S.	....	....	......	175′ seine	10–15′	1:30			3 hauls, main beach.
		....	....	8:15 A.M.	......	....	....	....	......	Bt, dredge	botm.	2:30			12 hauls 10 to 20 mi. ea.
	Salinas Bay, Carmen Id. (anch) Perice Pt., S.63°E.; White Pt. S.29°W.	H.O. 2181 (1904)	Apr. 2	7:00 P.M.	4½	....	....	....	......	e.l.; dip.	surf.	2:00			
			Apr. 3	8:00 A.M.	......	fine S.	....	....	......	175′ seine	10′	3:15	....	....	6 hauls NW. beach.
		....	"	8:00 A.M.	......	....	....	....	......	dyn.	8–18′	3:15	....	....	6 shots.
				9:00 A.M.	......	....	....	....	......	3½′ Tne.	botm.	2:15	....	....	6 hauls 20 mi. ea.
	Mulege Anchorage, Mouth of Conception Bay (anch). Sombrerito Pt. S.44°W.; Gallite Pt. S.54°E.	H.O. 849 (1878)	Apr. 4	8:00 A.M.	......	....	....	....	......	Bt. dredge	"	3:30	....	....	14 hauls varying time.
				1:00 P.M.	......	....	....	....	......	dyn.	6–8′	1:00	....	....	2 shots, 1 shot lost.

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	De
				2:00 P.M.	...
D. 5682	So. Part of Conception Bay (anch) Concep. Peak, S.22°E.; 500′ Peak, S.27°W.	H.O. 849 (1878)	Apr. 5	2:00 P.M.	...
			Apr. 6	8:00 A.M.	...
				2:00 P.M.	...
				7:45 P.M.	
	"	"	Apr. 7	9:00 A.M.	...
		....	....	"	...
	Ranada Pt. S.83°W.; R. tan. Ricason Id. S.39°E.	....	....	9:15 A.M.	...
		....	Apr. 8	8:30 A.M.	...
				"	...
	Mulege Anchorage (anch)	"	"	5:00 P.M.	...
	San Francisquito Bay (anch) NW. tan. N.11°E.; Eastern tangent N.80°E.	H.O. 630 (1878)	Apr. 9	3:30 P.M.	...
			....	7:00 P.M.	
	Angel de la Guardia Id. SE. Side (anch) E. tan. Pond Id. N.34°E.; E. tan. Isla Partida S.28°E.	H.O. 620 (1909)	Apr. 10	1:30 P.M.	...
			....	"	...
				3:45 P.M.	..
	Tiburon Is. So. side (anch); Red Bluff Pt. S.86°W. S. tan. Turner's Is. S.47°E.	"	Apr. 11	"	..
		....	....	8:30 P.M.	
		....	Apr. 12	8:00 A.M.	..
		....	....	8:30 A.M.	..
		....	....	9:00 A.M.	..
	San Esteban Id. (anch) NE. tan. N.5°W.; 25′ Rock, S.54°W.	"	Apr. 13	1:15 P.M.	..
		....	....	1:30 P.M.	..
	San Pedro Martir Id.	....	Apr. 14	11:55 A.M.	..
	Guaymas, (anch)	H.O. 640 (1878)	.... Apr. 15	.... 7:00 A.M.	
	Santa Catalina Id., (anch)	H.O. 850 (1878)	Apr. 16	9:15 A.M.	..
	Santa Cruz Id.	H.O. 621 (1909)	Apr. 16	3:15 P.M.	..
	Pichilinque Harbor (anch) off Coaling Sta.	H.O. 2087 (1902)	Apr. 17	2:00 P.M.	..
	San Gabriel Bay, Espiritu Santo Id. (anch)	H.O. 2193 (1914)	Apr. 19	9:00 A.M.	..

acter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Surface	Botm.						
.	....	....	......	100′ seine	5′	2:45	....	....	7 hauls, mouth of Mulege R.
....	....	....	......	Bt. dredge	botm.	2:30	....	....	8 hauls 10-20 mi. ea. no seining beach.
....	....	....	......	dyn.	3–15′	7:30	....	....	13 shots.
....	....	....	......	Bt. dredge	botm.	4:00	....	....	5 hauls 20 m. to 1 hr.
....	....	....	......	e.l., dip.	surf.	1:15			
....	....	....	......	dyn.	15′	3:30	....	....	6 shots.
....	....	....	......	Bt. dredge	botm.	2:30	....	....	7 hauls varying time
Co.	....	....	......	175′ seine	5–10′	3:00	....	....	3 hauls, beaches near anchorage.
....	....	....	......	dyn.	15′	2:30	....	....	5 shots.
o.	....	....	......	175′ seine	10′	"	....	....	3 hauls beaches near anchorage.
....	....	....	......	....	......	....	....	....	Stopped for Bill of Health only.
....	....	....	......	dyn.	8–15′	2:30	....	....	2 shots.
....	....	....	......	e.l., dip.	surf.	"			
....	....	....	......	Bt. dredge	botm.	4:00	....		8 hauls varying time.
....	....	....	......	dyn.	20′	3:00	....	....	5 shots. No beach for seining.
....	....	....	......	dyn.	6–25′	1:45	....	....	4 shots.
	....	....	......	175′ seine	10–15′	"	....	....	4 hauls beach E. of Red Bluff Is.
....	....	....	......	e.l., dip.	surf.	:05	....	....	Current too strong for use of light.
....	....	....	......	Bt. dredge	botm.	3:00	....	....	6 hauls varying time.
	....	....	......	100′ seine	8′	1:00	....	....	2 hauls same beach.
....	....	....	......	dyn.	15′	2:15	....	....	6 shots.
....	....	....	......	Bt. dredge	botm.	2:45	....	....	5 hauls, 20 mi. ea.
....	....	....	......	dyn.	8–20′	2:30	....	....	5 shots.
....	....	....	......	....	......	....	....	....	Choppy sea; too rough to land.
....	....	....	......	....	......	....	....	....	For Bill of Health and mail.
....	....	....	......	dyn.	10–15′	2:00	....	....	7 shots.
....	....	....	......	dyn.	10′	1:30	....	....	4 shots.
....	....	....	......	dyn.	8′	2:30	....	....	6 shots.
....	....	....	......	....	......	....	....	....	Stopped 3 hrs. for inspection of pearl oyster industry.

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
				2:00 P.M.	....	M.	....	....	....	100′ seine	5′	2:45	....	....	7 hauls, mouth of Mulege R.
D. 5682	So. Part of Conception Bay (anch) Concep. Peak, S.22°E.; 500′ Peak, S.27°W.	H.O. 849 (1878)	Apr. 5	2:00 P.M.	....	....	....	....	....	Bt. dredge	botm.	2:30	....	....	8 hauls 10-20 mi. ea. no seining beach.
			Apr. 6	8:00 A.M.	....	....	....	....	....	dyn.	3–15′	7:30	....	....	13 shots.
				2:00 P.M.	....	....	....	....	....	Bt. dredge	botm.	4:00	....	....	5 hauls 20 m. to 1 hr.
				7:45 P.M.	14	....	....	....	....	e.l., dip.	surf.	1:15			
	“	“	Apr. 7	9:00 A.M.	....	....	....	....	....	dyn.	15′	3:30	....	....	6 shots.
		....	....	“	....	....	....	....	....	Bt. dredge	botm.	2:30	....	....	7 hauls varying time
	Ranada Pt. S.83°W.; R. tan. Ricason Id. S.39°E.	....	....	9:15 A.M.	....	S., Co.	....	....	....	175′ seine	5–10′	3:00	....	....	3 hauls, beaches near anchorage.
		....	Apr. 8	8:30 A.M.	....	....	....	....	....	dyn.	15′	2:30	....	....	5 shots.
				“	....	S. Co.	....	....	....	175′ seine	10′	“	....	....	3 hauls beaches near anchorage.
	Mulege Anchorage (anch)	“	“	5:00 P.M.	....	....	....	....	....	....	....	....	....	....	Stopped for Bill of Health only.
	San Francisquito Bay (anch) NW. tan. N.11°E.; Eastern tangent N.80°E.	H.O. 630	Apr. 9	3:30 P.M.	....	....	....	....	....	dyn.	8–15′	2:30	....	....	2 shots.
		(1878)	....	7:00 P.M.	10½	....	....	....	....	e.l., dip.	surf.	“			
	Angel de la Guardia Id. SE. Side (anch) E. tan. Pond Id. N.34°E.; E. tan. Isla Partida S.28°E.	H.O. 620	Apr. 10	1:30 P.M.	....	....	....	....	....	Bt. dredge	botm.	4:00	....		8 hauls varying time.
		(1909)	....	“	....	....	....	....	....	dyn.	20′	3:00	....	....	5 shots. No beach for seining.
				3:45 P.M.	....	....	....	....	....	dyn.	6–25′	1:45	....	....	4 shots.
	Tiburon Is. So. side (anch); Red Bluff Pt. S.86°W. S. tan. Turner's Is. S.47°E.	“	Apr. 11	“	....	S.	....	....	....	175′ seine	10–15′	“	....	....	4 hauls beach E. of Red Bluff Is.
		....	....	8:30 P.M.	9½	....	....	....	....	e.l., dip.	surf.	:05	....	....	Current too strong for use of light.
		....	Apr. 12	8:00 A.M.	....	....	....	....	....	Bt. dredge	botm.	3:00	....	....	6 hauls varying time.
		....	....	8:30 A.M.	....	S.	....	....	....	100′ seine	8′	1:00	....	....	2 hauls same beach.
		....	....	9:00 A.M.	....	....	....	....	....	dyn.	15′	2:15	....	....	6 shots.
	San Esteban Id. (anch) NE. tan. N.5°W.; 25′ Rock, S.54°W.	“	Apr. 13	1:15 P.M.	....	....	....	....	....	Bt. dredge	botm.	2:45	....	....	5 hauls, 20 mi. ea.
		....	....	1:30 P.M.	....	....	....	....	....	dyn.	8–20′	2:30	....	....	5 shots.
	San Pedro Martir Id.	....	Apr. 14	11:55 A.M.	....	....	....	....	....	....	....	....	....	....	Choppy sea; too rough to land.
	Guaymas, (anch)	H.O. 640 (1878)	.... Apr. 15	.... 7:00 A.M.	....	....	....	....	....	....	....	....	....	....	For Bill of Health and mail.
	Santa Catalina Id., (anch)	H.O. 850 (1878)	Apr. 16	9:15 A.M.	....	....	....	....	....	dyn.	10–15′	2:00	....	....	7 shots.
	Santa Cruz Id.	H.O. 621 (1909)	Apr. 16	3:15 P.M.	....	....	....	....	....	dyn.	10′	1:30	....	....	4 shots.
	Pichilinque Harbor (anch) off Coaling Sta.	H.O. 2087 (1902)	Apr. 17	2:00 P.M.	....	....	....	....	....	dyn.	8′	2:30	....	....	6 shots.
	San Gabriel Bay, Espiritu Santo Id. (anch)	H.O. 2193 (1914)	Apr. 19	9:00 A.M.	....	....	....	....	....	....	....	....	....	....	Stopped 3 hrs. for inspection of pearl oyster industry.

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	De
D. 5682	Ceralbo Is.	H.O. 621 (1909)	Apr. 19	4:00 P.M.	. . .
	San Jose del Cabo Bay (anch.)	H.O. 1667 (1898)	Apr. 20	6:00 A.M.	. . .
	West Coast of Lower Cal. between Cape St. Lucas & Port San Bartolome.				
D. 5683	Off Cape St. L.; Cabo Falso N.53°W.; Cabeza Belleno N.; (22° 46′ 45″N., 109° 50′ 15″W.)	H.O. 1664 (1899)	Apr. 20	12:48 P.M.	6
				1:44 P.M.	. . .
D. 5684	So. of Magdalena Bay, (23° 23′ 30″N., 112° 00′ 30″W.)	. . . .	. . . .	6:25 A.M.	17
		"	Apr. 21		
		. . . .	. . . .	8:49 A.M.	. . .
D. 5685	So. of Abreojos Pt. (25° 42′ 45″N., 113° 38′ 30″W.)	H.O. 1493 (1908)	Apr. 22	8:14 A.M.	6
			. . . .	9:16 A.M.	. . .
D. 5686	SW. of Abreojos Pt. (26° 14′ 00″N., 114° 00′ 00′W.)	"	Apr. 22	3:16 P.M.	9
		. . . .	. . . .	4:20 P.M.	. .
	Port San Bartolome (anch) Entrance Rock, N.79°W.; S. tan. Coffin Id. S.52°W.	H.O. 1204 (1890)	Apr. 23	7:00 A.M.	. .
	Between Port San Bartolome, Lower Cal., Mex. & San Francisco, Cal., U. S. A.				
D. 5687	So. of Cedros Id. W. tan. Natividad Id. N.10°E. Breaker Pt., Lower Cal. N.72°E. (27° 39′ 15″N., 115° 16′ 00″W.)	H.O. 1310 (1909)	Apr. 23	12:42 P.M.	4
			. . . .	1:29 P.M.	. .
D. 5688	So. of C. Id. W. tan. Nat. Id. N. 15°E.; Breaker Pt., Lower Cal. N.72°E. (27° 38′ 45″N., 115° 17′ 40″W.)	. . . .	. . . .	2:35 P.M.	5
		"	Apr. 23	3:22 P.M.	. .
D. 5689	E. of Guadalupe Id. Hat Mt. N.59°E. St. Vincent Pk. N.47°E. (29° 23′ 00″N., 116° 14′ 00″W.)	H.O. 1193 (1909)	Apr. 24	6:20 A.M.	8
			. . . .	7:32 A.M.	
D. 5690	East of Guadalupe Id. (29° 29′ 00″N., 116° 18′ 00″W.)	"	Apr. 24	10:18 A.M.	11
		. . . .	. . . .	11:33 A.M.	. .
D. 5691	Off Lower Cal. SW. of San Diego (31° 08′ 20″N., 118° 29′ 30″W.)	H.O. 1006 (1887)	Apr. 25	6:17 A.M.	8
			. . . .	7:30 A.M.	. .
D. 5692	Off Lower Cal. SW. of San Diego. (31° 23′ 45″N., 118° 31′ 30″W.)	. . . .	Apr. 25	11:32 A.M.	10
		"	. . . .	1:03 P.M.	. .
D. 5693	W. of San Nicholas Id. Cal. (33° 13′ 30″N., 120° 04′ 30″W.)	C.S. 5002 (1904)	Apr. 26	6:11 A.M.	4
		. . . .	. . . .	6:57 A.M.	. .
D. 5694	NW. of San Nicholas Id., Cal. (33° 24′ 36″ N., 120° 12′ 30″W.)	. . . .	Apr. 26	9:16 A.M.	6
		"	. . . .	10:20 A.M.	. .
D. 5695	"	"	Apr. 26	1:13 P.M.	4
	(33° 33′ 00″N., 120° 17′ 30″W.)	. . . .	. . . .	2:14 P.M.	. .

cter of Bottom	Temperature F. Air	Sur-face	Botm.	Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
....	....	....	......	dyn.	10–20′	1:30	....	....	6 shots.
....	....	....	......	....	....	.....	....	....	Short stop only.
gn.M;G.	70°	73°	39.1°	Luc.sdr.					
....	69°	73°	......	12′ Agz.	botm.	0:15	S26°W.	1.5	Frame badly bent.
	64°	67°	?	....	....	.....	....	....	Wire parted while heaving in. Sounding instrument lost.
....	66°	67°	......	"	"	:30	NWxW	?	
Co.	60°	61°	?	....	....	.....	....	....	Thermo defective.
....	61°	61°	......	"	"	"	WxS	?	
; Glob.	60°	61°	37.3°						
....	61°	61°	......	"	"	:20	"	?	
	....	....	......	250′ seine	20′	1:00	....	....	1 haul on SE. beach.
; Glob.	61°	60°	41.1	Luc.sdr.					
....	62°	60°	......	12′ Agz.	botm.	:30	S.72°W	1.5	
	61°	60°	39.9						
....	61°	60°	......	"	"	"	S.85°W	2.0	
fne S; Glob.	58°	58°	?	....	....	.....	....	....	Thermo defective.
....	58°	58°	......	"	"	"	N87°W.	?	
Glob.	60°	58°	38.1						
....	60°	58°	......	"	"	:18	S82°W.	?	
.	57°	59°	37.2						
....	58°	59°	....	.. "	"	:20	"	?	
	58°	59°	37.1°						
....	61°	60°	......	"	"	"	"	?	
	54°	56°	?	....	....	.....	....	....	Wire parted while heaving in. Sounding instruments lost.
....	53°	54°	......	"	"	:30	N.86°W	?	
.	60	57°	?	....	....	.....	....	....	Thermo did not capsize.
....	56°	57°	......	"	"	"	S.63°W.	?	
Glob.	58°	57°	38.9						
....	57°	56°	......	"	"	"	S.85°W.	?	

Appendix C — Continued.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
D. 5682	Ceralbo Is.	H.O. 621 (1909)	Apr. 19	4:00 P.M.	......	......	....	....	......	dyn.	10–20′	1:30	....	....	6 shots.
	San Jose del Cabo Bay (anch.)	H.O. 1667 (1898)	Apr. 20	6:00 A.M.	......	......	....	....	......	......	......	......	....	....	Short stop only.
	West Coast of Lower Cal. between Cape St. Lucas & Port San Bartolome.														
D. 5683	Off Cape St. L.; Cabo Falso N.53°W.; Cabeza Belleno N.; (22° 46′ 45″N., 109° 50′ 15″W.)	H.O. 1664	Apr. 20	12:48 P.M.	630	crs S;gn.M;G.	70°	73°	39.1°	Luc.sdr.					
		(1899)		1:44 P.M.	......	......	69°	73°	......	12′ Agz.	botm.	0:15	S26°W.	1.5	Frame badly bent.
D. 5684	So. of Magdalena Bay, (23° 23′ 30″N., 112° 00′ 30″W.)	.... "	.... Apr. 21	6:25 A.M.	1760	?	64°	67°	?	......	......	......	....	....	Wire parted while heaving in. Sounding instrument lost.
		....	....	8:49 A.M.	......	......	66°	67°	......	"	"	:30	NWxW	?	
D. 5685	So. of Abreojos Pt. (25° 42′ 45″N., 113° 38′ 30″W.)	H.O. 1493	Apr. 22	8:14 A.M.	645	Bk S; Co.	60°	61°	?	......	......	......	....	....	Thermo defective.
		(1908)	....	9:16 A.M.	......	......	61°	61°	......	"	"	"	WxS	?	
D. 5686	SW. of Abreojos Pt. (26° 14′ 00″N., 114° 00′ 00′W.)	"	Apr. 22	3:16 P.M.	930	gn M; Glob.	60°	61°	37.3°						
		....	....	4:20 P.M.	......	......	61°	61°	......	"	"	:20	"	?	
	Port San Bartolome (anch) Entrance Rock, N.79°W.; S. tan. Coffin Id. S.52°W.	H.O. 1204 (1890)	Apr. 23	7:00 A.M.	......	S.	....	....	......	250′ seine	20′	1:00	....	....	1 haul on SE. beach.
	Between Port San Bartolome, Lower Cal., Mex. & San Francisco, Cal., U. S. A.														
D. 5687	So. of Cedros Id. W. tan. Natividad Id. N.10°E. Breaker Pt., Lower Cal. N.72°E. (27° 39′ 15″N., 115° 16′ 00″W.)	H.O. 1310	Apr. 23	12:42 P.M.	480	gn.M; Glob.	61°	60°	41.1	Luc.sdr.					
		(1909)	....	1:29 P.M.	......	......	62°	60°	......	12′ Agz.	botm.	:30	S.72°W	1.5	
D. 5688	So. of C. Id. W. tan. Nat. Id. N. 15°E.; Breaker Pt., Lower Cal. N.72°E. (27° 38′ 45″N., 115° 17′ 40″W.)	....	....	2:35 P.M.	525	"	61°	60°	39.9						
		"	Apr. 23	3:22 P.M.	......	......	61°	60°	......	"	"	"	S.85°W	2.0	
D. 5689	E. of Guadalupe Id. Hat Mt. N.59°E. St. Vincent Pk. N.47°E. (29° 23′ 00″N., 116° 14′ 00″W.)	H.O. 1193	Apr. 24	6:20 A.M.	879	gyM; fne S; Glob.	58°	58°	?	......	......	......	....	....	Thermo defective.
		(1909)	....	7:32 A.M.		......	58°	58°	......	"	"	"	N87°W.	?	
D. 5690	East of Guadalupe Id. (29° 29′ 00″N., 116° 18′ 00″W.)	"	Apr. 24	10:18 A.M.	1101	gnM; Glob.	60°	58°	38.1						
		....	....	11:33 A.M.	......	......	60°	58°	......	"	"	:18	S82°W.	?	
D. 5691	Off Lower Cal. SW. of San Diego (31° 08′ 20″N., 118° 29′ 30″W.)	H.O. 1006	Apr. 25	6:17 A.M.	868	gy M.	57°	59°	37.2						
		(1887)	....	7:30 A.M.	......	......	58°	59°	......	"	"	:20	"	?	
D. 5692	Off Lower Cal. SW. of San Diego. (31° 23′ 45″N., 118° 31′ 30″W.)	....	Apr. 25	11:32 A.M.	1076	"	58°	59°	37.1°						
		"	....	1:03 P.M.	......	......	61°	60°	......	"	"	"	"	?	
D. 5693	W. of San Nicholas Id. Cal. (33° 13′ 30″N., 120° 04′ 30″W.)	C.S. 5002 (1904)	Apr. 26	6:11 A.M.	451	?	54°	56°	?	......	......	......	....	....	Wire parted while heaving in. Sounding instruments lost.
		....	....	6:57 A.M.	......	......	53°	54°	......	"	"	:30	N.86°W	?	
D. 5694	NW. of San Nicholas Id., Cal. (33° 24′ 36″ N., 120° 12′ 30″W.)	....	Apr. 26	9:16 A.M.	640	gn M.	60	57°	?	......	......	......	....	....	Thermo did not capsize.
		"	....	10:20 A.M.	......	......	56°	57°	......	"	"	"	S.63°W.	?	
D. 5695	"	"	Apr. 26	1:13 P.M.	534	gn,S. Glob.	58°	57°	38.9						
	(33° 33′ 00″N., 120° 17′ 30″W.)	....	....	2:14 P.M.	......	......	57°	56°	......	"	"	"	S.85°W.	?	

Appendix C — Concluded.

Station No.	Position	Chart	Date	Time	De
D. 5696	W. of Pt. Buchon, Cal., Pine Mt. N.42°E. (35°18′30″N., 121° 28′ 00″W.)	C.S. 5002 (1904)	Apr. 27	6:22 A.M. 7:07 A.M.	4 ...
D. 5697	W. of Piedras Blancas, Cal., Silver Pk. N. 40°E. Pine Mt. N.75°E. (35° 35′ 00″N. 121° 39′ 00″W.)	"	Apr. 27	10:07 A.M. 10:48 A.M.	4 ...
D. 5698	Off Pt. Sur, Cal. Pt. Sur. N.6°W. Juniperre Mt. N.47°E.; (35° 50′ 00″N., 121° 49′ 30″W.)	"	Apr. 27	2:07 P.M. 2:59 P.M.	4 ...
D. 5699	Off Pt. Sur, Cal.; Pt. Sur Light N.12°E. (36° 00′ 30″N., 122° 00′ 00″W.)	"	Apr. 27	6:14 P.M. 7:06 P.M.	6 ...

Appendix D.

Record of monthly mean temperatures at La Paz, Lower California during the year 1910 (Fahrenheit).

	7 A. M.	Noon	Rain.
January,	60°	66°	
February,	58	68	
March,	62	71	
April,	66	76	
May,	69	84	
June,	73	83	
July,	72	84	2 days
August,	80	87	2 "
September,	80	87	5 "
October,	75	82	2 "
November,	69	76	
December,	63	71	
Annual mean,	74	78	

From daily records made by Lucien N. Sullivan, U. S. Consul.

ter of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
	Air	Surface	Botm.						
ple	50°	54°	39.9	....	......	.....	....	....	Shot did not detach.
....	52°	54°	......	12′ Agz.	botm.	:14	N63°W	?	Frame badly twisted.
gk.S.	55°	52°	39.8						
....	56°	53°	......	"	"	:31	N72°W	?	
ple	53°	53°	39.9	....	......	.....	....	....	Shot failed to detach.
....	53°	53°	......	"	"	:20	"	?	
	51°	52°	37.9						
....	52°	52°	......	"	"	:30	S.86W.	?	

Appendix E.

Scientific Results of the Expedition to the Gulf of California in Charge of C. H. Townsend, by the U. S. Fisheries Steamship "Albatross" in 1911. Commander G. H. Burrage, U. S. N., Commanding.

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Zoölogical Papers Published.

I. Voyage of the 'Albatross' to the Gulf of California in 1911. By Charles Haskins Townsend. Bull. Am. Mus. Nat. Hist., Vol. XXXV, Art. xxiv, pp. 399–476. July, 1916.

II. The Northern Elephant Seal. By Charles Haskins Townsend. Zoologica. N. Y. Zoöl. Soc., Vol. I, No. 8, pp. 155–173, figs. 52–72. N. Y. April 15, 1912.

III. Mammals Collected in Lower California, with Descriptions of New Species. By Charles Haskins Townsend. Bull. Am. Mus. Nat. Hist., Vol. XXXI, Art. xiii, pp. 117–130, 4 illust. June 14, 1912.

IV. List of Insects Collected in Lower California. By John A. Grossbeck. Bull. Am. Mus. Nat. Hist., Vol. XXXI, Art. xxiv, pp. 323–326. Sept. 13, 1912.

V. Echinoderms from Lower California with Descriptions of New Species. By Hubert Lyman Clark. Bull. Am. Mus. Nat. Hist., Vol. XXXII, Art. viii, pp. 185–236. July 9, 1913.

VI. Shore Fishes from Lower California with Descriptions of New Species. By Raymond C. Osburn and John Treadwell Nichols. Bull. Am. Mus. Nat. Hist., Vol. XXXV, Art. xvi, pp. 139–181, figs. 1–15. May 26, 1916.

Appendix C — Concluded.

Station No.	Position	Chart	Date	Time	Depth F	Character of Bottom	Temperature F.			Apparatus	Depth	Dur.	Direc.	Dis.	Remarks
							Air	Surface	Botm.						
D. 5696	W. of Pt. Buchon, Cal., Pine Mt. N.42°E. (35°18′30″N., 121° 28′ 00″W.)	C.S. 5002	Apr. 27	6:22 A.M.	440	no sample	50°	54°	39.9	....	......	.....	....	....	Shot did not detach. Frame badly twisted.
		(1904)	....	7:07 A.M.	......	....	52°	54°	......	12′ Agz.	botm.	:14	N63°W	?	
D. 5697	W. of Piedras Blancas, Cal., Silver Pk. N. 40°E. Pine Mt. N.75°E. (35° 35′ 00″N. 121° 39′ 00″W.)	“	Apr. 27	10:07 A.M.	485	gn M. gk.S.	55°	52°	39.8						
		....	....	10:48 A.M.	......	....	56°	53°	......	“	“	:31	N72°W	?	
D. 5698	Off Pt. Sur, Cal. Pt. Sur. N.6°W. Juniperre Mt. N.47°E.; (35° 50′ 00″N., 121° 49′ 30″W.)	“	Apr. 27	2:07 P.M.	475	no sample	53°	53°	39.9	....	......	.....	....	....	Shot failed to detach.
		....	....	2:59 P.M.	......	....	53°	53°	......	“	“	:20	“	?	
D. 5699	Off Pt. Sur, Cal.; Pt. Sur Light N.12°E. (36° 00′ 30″N., 122° 00′ 00″W.)	“	Apr. 27	6:14 P.M.	659	gn M.	51°	52°	37.9						
		....	....	7:06 P.M.	......	....	52°	52°	......	“	“	:30	S.86W.	?	

Appendix D.

Record of monthly mean temperatures at La Paz, Lower California during the year 1910 (Fahrenheit).

	7 A. M.	Noon	Rain.
January,	60°	66°	
February,	58	68	
March,	62	71	
April,	66	76	
May,	69	84	
June,	73	83	
July,	72	84	2 days
August,	80	87	2 “
September,	80	87	5 “
October,	75	82	2 “
November,	69	76	
December,	63	71	
Annual mean,	74	78	

From daily records made by Lucien N. Sullivan, U. S. Consul.

Appendix E.

SCIENTIFIC RESULTS OF THE EXPEDITION TO THE GULF OF CALIFORNIA IN CHARGE OF C. H. TOWNSEND, BY THE U. S. FISHERIES STEAMSHIP "ALBATROSS" IN 1911. COMMANDER G. H. BURRAGE, U. S. N., COMMANDING.

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II. The Northern Elephant Seal. By Charles Haskins Townsend. Zoologica. N. Y. Zoöl. Soc., Vol. I, No. 8, pp. 155–173, figs. 52–72. N. Y. April 15, 1912.

III. Mammals Collected in Lower California, with Descriptions of New Species. By Charles Haskins Townsend. Bull. Am. Mus. Nat. Hist., Vol. XXXI, Art. xiii, pp. 117–130, 4 illust. June 14, 1912.

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  Jour. N. Y. Bot. Gard. Dec. 1911, pp. 263–272.
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  Monatsschrift fur Kakteenkund, Vol. 23, p. 181.

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Monograph of the Cacti, Britton and Rose.

MAP OF THE LOWER CALIFORNIA REGION
SHOWING ROUTE OF THE ALBATROSS EXPEDITION IN 1911
UNDER THE DIRECTION OF C.H. TOWNSEND

59.92E(117:71.2)

Article XXV.—A MARSUPIAL FROM THE BELLY RIVER CRETACEOUS. WITH CRITICAL OBSERVATIONS UPON THE AFFINITIES OF THE CRETACEOUS MAMMALS.

By W. D. Matthew.

Plates II–VI.

CONTENTS.

		Page
I.	Review of previous knowledge of Upper Cretaceous mammals. Affinities of the Multituberculata and of the Cretaceous Trituberculata....	477
II.	*Eodelphis browni* new genus and species. Diagnosis. Circumstances of discovery; horizon, locality and accompanying fauna. Description of type and comparisons with Belly River and Lance genera............	482
III.	Redescription of *Thlæodon padanicus* Cope. Affinities and comparison with *Eodelphis* and other Cretaceous trituberculates.............	492
IV.	Conclusions and interpretation of the evidence......................	498

I. Review of Previous Knowledge of Upper Cretaceous Mammals.

Cretaceous mammals are exceedingly rare and extremely fragmentary. In the upper or true Cretaceous they are known only from Western North America. The earliest record dates back to forty years ago, in 1876, when Professor E. D. Cope[1] described under the name of *Paronychodon lacustris* a tooth from the Judith River formation of Montana, which he supposed to be reptilian but which has since been recognized (Osborn 1891) as the incisor tooth of a multituberculate mammal, probably related to *Ptilodus*.[2] The first discovery of recognized mammals is due to Dr. J. L. Wortman, who found in 1882 two teeth and a fragment of a humerus in the Lance formation of Wyoming, which were described by Professor Cope[3] under the name of *Meniscoëssus conquistus*. The type specimens of *Paronychodon* and *Meniscoëssus* are in the American Museum Cope Collection. The second tooth associated with the primary type of *M. conquistus* was described as a premolar. It is not mammalian, but is the tooth of an ankylosaurid dinosaur, either *Palæoscincus* or some near ally. The distal end of the humerus is mammalian, and probably multituberculate, but appears too small to belong to *Meniscoëssus.*

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[1] Cope, 1876. Descriptions of some Vertebrate Remains from the Fort Union Beds of Montana. Palæont. Bull. No. 22, Nov. 13, 1876, repub. in Proc. Acad. Nat. Sci. Phila., 1876, p. 256.

[2] Professor Osborn identifies it provisionally as *Meniscoëssus*.

[3] Cope, 1882. Mammalia in the Laramie Formation. American Naturalist, Vol. XVI, pp. 830–831.

Eighteen genera and thirty-one species were published by Marsh in 1889[1] and 1892,[2] all of them based upon a collection of teeth and fragmentary jaws obtained by Hatcher, Beecher and Peterson from ant-hills and small washes and blowouts in the Lance formation of Niobrara County (formerly included in Converse Co.) Wyoming. This collection is chiefly in the Yale University Museum, partly in the National Museum at Washington. The localities and occurrence of these ant-hill fossils are briefly described in a very interesting article recently contributed by Professor Lull to Popular Science Monthly[3] and more fully discussed in an article in the American Journal of Science.[4]

The most complete specimen known from the Lance is the incomplete upper and lower jaw found by Doctor Wortman in South Dakota and described by Cope in 1892[5] under the name of *Thlæodon padanicus.* This important specimen is also in the American Museum Cope Collection, and is redescribed and refigured in section III of this paper.

Osborn in 1891[6] published a review of parts i and ii of Marsh's Discovery of Cretaceous Mammalia, in which the genera were revised and the various teeth provisionally correlated on the evidence then available. In 1893[7] Osborn described in part a second ant-hill collection of fossil mammals from the Lance formation, obtained by Wortman and Peterson for the American Museum. He figured and correlated a series of multituberculate and trituberculate teeth, identifying certain types with the genera described by Cope and Marsh, and discussed the affinities of both groups and the faunal relations of the Cretaceous mammals. In 1898[8] Osborn applied to three of the unnamed types of his 1893 paper the names *Synconodon sexicuspis, Ectoconodon petersoni* and *Protolambda hatcheri,* comparing them with the Periptychidæ and Pantolambdidæ of the Paleocene Amblypoda.

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[1] Marsh, 1889. Discovery of Cretaceous Mammalia, Part I, American Journal of Science, Vol. XXXVIII, pp. 81–92, pll. ii–v; Part II, *ibid.* pp. 177–180, pll. vii–viii.

[2] Marsh, 1892. Discovery of Cretaceous Mammalia, Part III, Amer. Journ. Sci., Vol. XLIII, pp. 249–262, pll. v–x.

[3] Lull, R. S., 1915. Ant-Hill Fossils. Pop. Sci. Monthly, Sept. 1915, pp. 236–243.

[4] Lull, R. S., 1915. The Mammals and Horned Dinosaurs of the Lance Formation of Niobrara County, Wyoming. Amer. Journ. Sci., Vol. XL, pp. 319–348.

[5] Cope, 1892. On a New Genus of Mammalia from the Laramie Formation. Amer. Nat., September, Vol. XXVI, p. 758, pl.

[6] Osborn, 1891. A Review of 'Discovery of the Cretaceous Mammalia.' Amer. Nat., Vol. XXV, pp. 595–611, 12 text figures.

[7] Osborn, 1893. Fossil Mammals of the Upper Cretaceous Beds. Bull. Amer. Mus. Nat. Hist., Vol. V, pp. 311–330, pll. vii–viii.

[8] Osborn, 1898. Evolution of the Amblypoda, Part I, Taligrada and Pantodonta. Bull. Amer. Mus. Nat. Hist., Vol. X, pp. 169–218. See pp. 170–172 and fig. 1.

Lambe in 1902[1] described two mammals from the Belly River, *Ptilodus primævus* and *Boreodon matutinus,* the first record of fossil mammals from this formation. The former species was based upon a jaw fragment with two well preserved teeth, the latter upon a single imperfect premolar tooth.

Somewhat in contrast to the rapid advance of our knowledge of American Tertiary mammals, little or nothing has been done with the Cretaceous mammals during the last twenty-three years since Osborn's paper of 1893. No further systematic studies have been made[2] upon the material already collected, and until very recently no further collections have been made, save for the two types described by Lambe. Doctor Lull in his recent paper refers to the additional material obtained by his party from the Lance and it is to be hoped that this will lead to the revision of the fauna which is greatly needed. I have from time to time studied these mammals in a desultory way in connection with new discoveries or researches among the early Tertiary mammals. My conclusions were briefly outlined incidentally to a discussion of the correlation of the later Cretacic and early Tertiary formations.[3] They may now be more fully expressed, as follows:

1. *The Multituberculates.* More than half the material belongs to two or more genera of Multituberculata (*Meniscoëssus* and *Cimolomys,* perhaps other small forms) allied to *Polymastodon, Ptilodus* and other Paleocene genera. The position of the Multituberculata has been variously estimated, some authorities associating them with Monotremes, others with Marsupials. So long as they were known only from teeth and jaws their affinities were a rather speculative and doubtful problem, not to be taken too seriously. Within the last few years, however, skulls and skeletons have been discovered of the Paleocene genera, and it is now possible to arrive at a reasonably certain estimate of their approximate relationships. The first of these discoveries was a skull and jaws with important parts of the skeleton of *Ptilodus* from the Fort Union formation, described by J. W. Gidley.[4] Mr. Gidley concluded that it was most nearly allied to the diprotodont marsu-

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[1] Lambe, 1902. New Genera and Species of the Belly River Series (Mid-Cretaceous), p. 79, pl. xv, figs. 13–15, in Osborn and Lambe, Vertebrata of the Mid-Cretaceous of the North West Territory. Contrib. Can. Pal., Vol. XXX (Quarto), Geol. Sur. Canada, Sept. 1902.

[2] Gidley in 1906, Proc. Wash. Acad. Sci., Vol. VIII, pl. v, figured two teeth from the Lance formation in illustration of a discussion upon the origin of the tritubercular molar. Osborn, 1907, Evolution of the Mammalian molar teeth, pp. 95–97, fig. 47, and Gregory, 1910, The Orders of Mammals, p. 169, have discussed their evidence from the same viewpoint, but without adding anything to the evidence as to their affinities.

[3] Matthew, 1914. Evidence of the Paleocene Vertebrate Fauna on the Cretaceous-Tertiary Problem. Bull. Geol. Soc. Amer., Vol. XXV, pp. 381–402.

[4] Gidley, 1909. Notes on the Fossil Mammalian Genus Ptilodus with Descriptions of New Species. Proc. U. S. Nat. Mus., Vol. XXVI, pp. 611–626, pl. 70.

pials. In 1910, W. K. Gregory,[1] after critical consideration of the evidence afforded by Gidley's *Ptilodus* skeleton, concluded that while related to the Marsupials, the Multituberculates should be considered as a distinct order, paralleling the diprotodont Marsupials, but not closely related or ancestral. In 1914, a skull of *Polymastodon* from the Puerco formation found by Dr. W. J. Sinclair was described by Dr. R. Broom,[2] who maintained that the Multituberculates were more nearly allied to the Monotremes and probably ancestral to them. A more complete skeleton of a genus closely allied to *Ptilodus* was obtained from the Torrejon by Dr. Sinclair in 1913 and described by Mr. Walter Granger in 1915 and 1916. Mr. Granger [3] concludes that the multituberculates, while more nearly allied to the marsupials than to the monotremes, are fundamentally distinct from either, representing apparently a separate branch of the mammalian phylum, which parallels certain marsupials in many respects, and monotremes in a few others but is in fact only distantly related, and may even be regarded as a separate subclass, coördinate with Prototheria, Metatheria and Eutheria, and equivalent in its stage of evolution to the Metatheria. To such a sub-class, if accepted, Marsh's term Allotheria would properly apply.

So far as the Upper Cretaceous and Paleocene multituberculates are concerned the evidence in favor of Mr. Granger's conclusions appears to me to be fairly conclusive. I am somewhat less certain about the affinities of *Plagiaulax* and its allies, and decidedly doubtful about the real position of *Tritylodon.*

The teeth of multituberculates are so highly characteristic and peculiar that there can be no doubt as to the near relationship of the Cretaceous genera to those of the Paleocene. It is also clear, as Osborn pointed out in 1891 and 1893, that the eight genera described by Marsh represent not more than two clearly defined generic types, *Meniscoëssus* Cope [4] and *Cimolomys* Marsh, the latter representing probably several closely allied genera of the *Ptilodus* group, which cannot be differentiated until better known.

2. *The Trituberculates.* The remainder of the Cretaceous mammals have tritubercular molars, but their affinities are uncertain. Teeth of similar type are found among polyprotodont marsupials, Insectivora, Chiroptera and creodonts and the earliest known stages in the evolution of

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[1] Gregory, 1910. The Orders of Mammals. Bull. Amer. Mus. Nat. Hist., Vol. XXVII, pp. 166–170.

[2] Broom, 1914. On the Structure and Affinities of the Multituberculata. Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, pp. 115–134.

[3] Granger, 1915. New Evidence of the Affinities of the Multituberculata (Abstract). Bull. Geol. Soc. Amer., Vol. XXVI, p. 152. Granger, 1916, in Amer. Mus. Bull., not yet published.

[4] *Meniscoëssus* is said to be related to *Polymastodon* (*Tæniolabis*); its affinities may perhaps be somewhat closer with *Catopsalis*, a related but smaller genus from the same horizon as *Polymastodon*.

artiodactyls, perissodactyls, condylarths, taligrades, tæniodonts, rodents, lemuroid primates etc. are either typically tritubercular, or clearly derivable from a tritubercular ancestry. These isolated teeth might represent marsupials or they might include ancestors of almost any or all of the placental orders. Marsh (1892, p. 257) regarded them as chiefly marsupials and compared them with *Didelphis* in particular, but intimated that others might be allied to the Insectivora. Osborn (1893, pp. 326, 329, 330) regarded them as representing doubtfully both marsupials and early ancestral placental types, while referring the multituberculates to the monotremes in accord with current views at that date.

No additional collections or better specimens of trituberculates have since been obtained from the Lance, and the evidence is still in the same unsatisfactory condition as in 1893. Some specimens show or indicate the characteristic marsupial angle of the jaw, but this was never shown to be associated with any particular type of teeth, except in *Thlæodon*, and Cope's description of this genus is erroneous and misleading in several important points. The dental formula was unknown in any of them, and while for various reasons it seemed probable that most or all of these Cretaceous trituberculates were marsupials, there was no conclusive proof of it. On the other hand there was not and is not any valid evidence for placing any of them in the placental group.

The Cretaceous age of the Lance formation has likewise been challenged. This problem I have elsewhere discussed,[1] and will merely observe now that my conclusions as to the relations of the vertebrate faunas from the Belly River Cretaceous to the Wasatch Eocene are confirmed on various points by subsequent discoveries and that I have seen no occasion to modify the opinions therein expressed. The specimen here described adds materially to the evidence that the Lance mammalian fauna was essentially Cretaceous, nearly related to that of the Belly River, sharply distinct from that of the Paleocene in that it consisted exclusively of multituberculates and marsupials, with no placental element, while that of the Paleocene is dominantly placental with a few surviving multituberculates and no recognized marsupials although a few of these may have been present.

Paronychodon of the Judith River is probably a multituberculate but not further determinable at present.

Of the two specimens described by Lambe from the Belly River one is certainly related to *Cimolomys* (*Cimolodon*) of the Lance and apparently not generically separable. The second (*Boreodon*) has been compared with *Thlæodon* but is practically indeterminate. The jaw here described is related to the Cimolestidæ of the Lance. Its marsupial affinities appear to be unquestionable, and afford evidence that the Cimolestidæ are nearly related to the Didelphidæ and at present cannot be separated from them by any distinctions of family value. The opossums appear therefore to have survived since the Cretaceous with comparatively little change.

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[1] Matthew, 1914, *l. c.*

The bearing of this upon the antiquity of the marsupial type of skull and dentition is obvious. Some authorities have held that the marsupial dentition is derived from that of the placentals through the partial suppression of the premolar replacement and that their inflected jaw is likewise a secondary feature. If this be true, we must at least suppose that the differentiation of the two phyla took place far back in the Mesozoic. The marsupials are certainly not derivable from early Tertiary Creodonta as Lydekker has suggested for the specimen here described shows that the modern didelphid type of marsupial long antedates the Tertiary. We cannot on the other hand suppose that the Tertiary placentals are derived from late Mesozoic marsupials, for there is no approach in any Paleocene placentals to the marsupial type.

II. EODELPHIS BROWNI, NEW GENUS AND SPECIES.

Plates II–VI and Text-Figs. 1–4.

Diagnosis. Order Marsupialia. Family Cimolestidæ = ?Didelphidæ.

Eodelphis browni gen. et sp. nov.

Type, No. 14169, left ramus of lower jaw nearly complete, symphyseal portion of right ramus; right zygomatic arch and temporal region of skull.

Horizon, Cretacic (Montana group) Belly River formation.

Locality, Sand Creek, 15 miles below Steveville, Red Deer River, Alberta.

Collector, Barnum Brown, American Museum Expedition of 1915.

Ordinal Characters.

(1) Three premolars, four true molars.

(2) Angle of jaw inflected in the usual marsupial style.

(3) Posterior end of jugal extending backward to take part in glenoid articulation.

(4) Occipital exposure of mastoid extensive.

Family characters.

(1) Incisors small, canine large, laniary, premolars trenchant, simple, molars tritubercular with large basin heels (as in Didelphidæ).

(2) Glenoid articulation transverse, deeply excavated, postglenoid process prominent (as in Didelphidæ).

(3) Incisors reduced in number (apparently more or less reduction in all the Cretaceous genera, but this is a character of doubtful family value).

Generic characters.

(1) Three lower incisors, the second somewhat enlarged, others minute, crowded, vestigial.
(2) No diastemata behind canine (cf. *Chironectes*).
(3) Symphysis compact, anterior portion of jaw rather deep and short, massive.
(4) Trigonids of molars moderately high, wider than long, protoconid not overtopping paraconid and metaconid, the paraconid not extended forward but equalling or slightly overtopping the metaconid in height.
(5) Angular process similar to *Didelphis* but broader.
(6) Coronoid process high, broad, condyles little above level of tooth row.
(7) Lower border of zygomatic arch compressed, thin.
(8) Occiput wide; mastoid exposure broad (cf. *Sarcophilus*); post-tympanic process a prominent plate.

Circumstances of Discovery. The specimen was discovered by Mr. Brown while engaged in undermining a Ceratopsian skull beneath which it lay. Being thus accidentally found during work with a heavy pick, it was badly shattered, and only by careful and thorough search was it possible to recover most of the fragments, while some were irrecoverably lost or destroyed. The specimen was entrusted to Mr. A. E. Anderson, and under his skilful ministrations the fragments were all accurately pieced together, the matrix removed and the specimen photographed and mounted. Considering the circumstances of discovery and the delicate fragile character of the fossil, both Mr. Brown and Mr. Anderson are to be congratulated upon the remarkably successful results of their labors. The jaw has suffered no important loss save for the condyle and part of the coronoid process; there may have been originally more of the skull than is now preserved, but from the absence of any fragments of other portions it is probable that very little has been destroyed.

Horizon, locality and accompanying fauna. It is most fortunate that this specimen is from a formation whose Cretaceous age cannot be questioned. The section along the Red Deer River[1] is an undisturbed one and shows the Belly River non-marine sandstones and shales lying between an upper and a lower member of the marine Cretaceous Fort Pierre formation equivalent to the Upper Senonian of Europe. The locality is a richly fossiliferous pocket from which Mr. Brown has secured for the American Museum a fine series of skulls and skeletons of dinosaurs. The genera are identical with or equivalent to the Judith River dinosaurs of Montana, and represent throughout earlier stages of the same phyla of dinosaurs as are found in the Lance formation and its equivalents in Montana, Wyoming and Colorado. The same relations hold true in other groups of reptiles, and, so far as the rarity of material permits comparison, in the mammals as well

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[1] Brown, 1914, Bull. Geol. Soc. Amer., Vol. XXV, p. 359.

PARTIAL LIST OF ASSOCIATED FAUNA.[1]

Mammalia.
- *'Ptilodus' primævus* Lambe, cf. *Cimolodon* Marsh.
- *Boreodon matutinus* Lambe, cf. *Stagodon* Marsh.
- *Eodelphis browni* nom. nov., cf. *Cimolestes* Marsh (partim).

Dinosauria.
- *Kritosaurus notabilis* (Lambe).
- *Trachodon marginatus* Lambe.
- " *selwyni* Lambe.
- " *altidens* Lambe.
- "*Stephanosaurus marginatus*" Lambe.
- *Hypacrosaurus altispinus* Brown.
- *Corythosaurus casuarius* Brown.
- *Monoclonius dawsoni* (Lambe).
- " *flexus* Brown.
- *Ceratops belli* (Lambe).
- " *canadensis* (Lambe).
- *Styracosaurus albertensis* Lambe.
- *Ankylosauridæ* sp. div.
- *Palæoscincus* sp.
- *Deinodon* sp. div.
- *Gorgosaurus libratus* Lambe.
- *Ornithomimus altus* Lambe.
- Gen. indesc. (Theropoda).
- *Stegoceras validus* Lambe (incertæ sedis).
- *Troödon formosus* Leidy (incertæ sedis).

Testudines.
- *Aspideretes foveatus* (Leidy).
- *Basilemys variolosa* (Cope).
- *Baëna antiqua* Lambe.
- *Boremys pulchra* Lambe.
- *Neurankylus eximius* Lambe.

Plesiosauria.
- *Cimoliasaurus* sp.

Rhynchocephalia.
- *Champsosaurus profundus* Cope.
- " *annectens* Cope.
- " *brevicollis* Cope.

Crocodilia.
- *Crocodilus humilis* Leidy.
- *Leidyosuchus canadensis* Lambe.

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[1] B. Brown, 1914, Bull. Geol. Soc. Am., Vol. XXV, p. 378.

Batrachia.
  ?*Scapherpeton tectum* Cope.
Pisces.
  Myledaphus bipartitus Cope.
  Accipenser albertensis Lambe.
  Lepisosteus occidentalis Leidy.
  Rhineastes cruciferus (Cope).
  Diphyodus longirostris Lambe.
Invertebrates.
  Unio danæ Meek & Hayden.
  " cf. *supenawensis* Stanton.
  Anodonta propatorius White.
  " sp.
Plants.
  Cunninghamites ?elegans Endlicher.
  Dammara sp.
  Castalia stantoni Knowlton.
  " sp. indesc.
  Aspidium sp.

Dammara acicularis Knowlton.[1]
Cunninghamites pulchellus Knowlton.
Populus cretacea Knowlton.
Castalia stantoni Knowlton.
Carpites judithæ Knowlton.

Description and Comparisons. The left ramus is complete except for the condyle and part of the coronoid process. The posterior molars are well preserved, the anterior ones damaged by corrosion and shattering; the premolars, canine and incisors are badly corroded, so that the enamel and more or less of the dentinal surface has disappeared and the original outlines must be inferred from the character of the corroded surfaces. The jaw has not been seriously damaged. A second fragment consists of the symphysis of the right ramus with the incisors and canine also badly corroded on the crowns. A third fragment consists of the anterior part of the zygoma, with most of the jugal and part of the zygomatic process of the maxillary. The posterior end of the jugal and its superior branch have been completely destroyed by corrosion, but the infra-orbital portion is well preserved, and most of the squamosal suture. The fourth fragment consists of most of the squamosal with the mastoid portion of the periotic bone. The glenoid and postglenoid regions are complete and well preserved, but the end of the zygomatic process is broken off, part of the cranial plate of the squamosal missing and the petrous portion of the periotic is broken off.

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[1] The following are also reported by W. J. Wilson in the Annual Report for 1915, Can. Geol. Sur., p. 205, as identified by Dr. Knowlton from collections made by Mr. C. H. Sternberg for the Canadian Survey.

Teeth: The *first incisor* is minute, its alveolus postero-internal to i_2. The *second incisor* is of moderate size, much smaller than the canine, not notably procumbent, the root rounded, the crown destroyed by corrosion. The *third incisor* is also minute its alveolus external to that of i_2, the crown corroded down to the roots. The *canine* is somewhat larger than in *Didelphis,* proportioned much as in that genus but apparently somewhat less curved and more ridged posteriorly. Its root is flat, oval in cross section and the crown has also lost heavily by corrosion. The premolars are not spaced. The *first premolar* is small, one-rooted, and had apparently a simple pointed compressed-oval crown, mostly corroded away. The *second premolar* is larger, two-rooted, with flattened-oval pointed trenchant crown and a small heel, so far as one can judge from what remains. The *third premolar* is larger than p_2, intermediate in characters between the second and third premolars of *Didelphis,* but the crown is considerably damaged by corrosion, and the tip broken off.

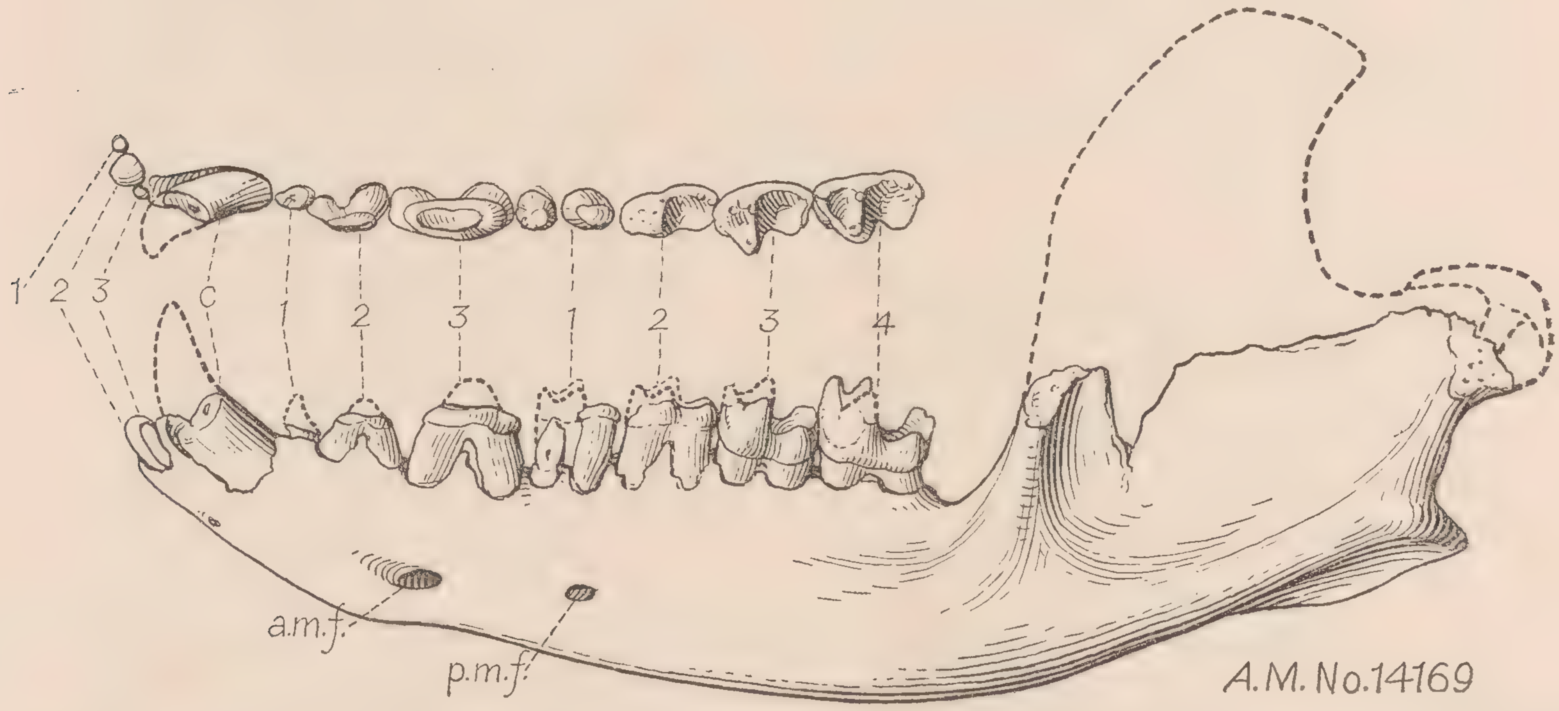

Fig. 1. *Eodelphis browni,* lower jaw of type, external view, and crown view of teeth, three halves natural size, No. 14169 *a.m.f.*, anterior mental foramen; *p.m.f.*, posterior mental foramen.

Of the *first molar* little remains but the roots, the crown being corroded and most of it lost. Its position in the jaw, more fully emerged than either p_3 or m_2 indicates it as belonging to the primary series (milk-molars and molars) and in view of the evident maturity of the animal, as shown by the wear of the molars, it is clearly not a deciduous tooth. It must therefore be assigned to the true molars as in the marsupials, and is not a milk-molar followed by a successional or premolar tooth as is the corresponding tooth of the placental mammals.[1]

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[1] Note on the Marsupial and Placental tooth formulas:— It is commonly stated that the marsupials have three premolars and four molars, the placentals four premolars and three molars. Although the premolars are usually simpler than the molars the essential difference lies not in the form of the teeth but in their replacement. The four anterior cheek teeth (milk molars) of the placental

The *second molar* is much worn although not badly corroded, and except that it is similar in size and general proportions to m_3 deserves no especial comment.

The *third molar* has a short moderately high trigonid and long deeply basined heel. The paraconid and metaconid are broken off, but were apparently of nearly equal height, much closer together than in *Didelphis* and the protoconid is somewhat lower and stands well apart from the inner cusps; entoconid and hypoconulid are high, distinct, close together at the postero-internal side of the basin, the hypoconid external and lower. There is a strong anteroexternal cingular ledge on the trigonid, similar to that in *Didelphis* but rising up sharply towards the much higher paraconid.

The *fourth molar* has the same construction as the third, save that the

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mammal are succeeded by a second or successional series, the true premolars. In the marsupial the third cheek tooth has a milk predecessor, the others do not, except that in certain South American Tertiary polyprotodonts the canines and anterior premolars are said to have milk predecessors.

The most probable interpretation of the difference in dental formula I take to be this; that in the marsupials the first dentition has been suppressed save for dp$\frac{3}{3}$ and the true molars, while the second dentition is not developed behind p$\frac{3}{3}$; in the placentals the first dentition is complete, except for dp$\frac{1}{1}$, the second developed as far back as p$\frac{4}{4}$. The dental formulæ would then be:

$$
\text{Marsupials}\quad \left.\begin{array}{r}
\text{incisors canine premolars molars}\\
1.2.3\ldots1\ldots\ldots1.2.3\ldots\\
\left.\begin{array}{r} 3\ldots1.2.3.4\\ \hline 3\ldots1.2.3.4\end{array}\right\}\text{First Series}\\
1.2.3\ldots1\ldots\ldots1.2.3\ldots
\end{array}\right\}\text{Second Series}
$$

$$
\text{Placentals}\quad \left.\begin{array}{l}
\text{incisors canine premolars molars}\\
1.2.3\ldots1\ldots\ldots1.2.3.4\\
\left.\begin{array}{l} 1.2.3\ldots1\ldots\ldots\ldots2.3.4\ldots1.2.3\\ \hline 1.2.3\ldots1\ldots\ldots\ldots2.3.4\ldots1.2.3\end{array}\right\}\text{First Series}\\
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It is quite possible that the additional incisors in some marsupials may have been originally characteristic of the group instead of being a secondary result of intercalation of one dentition with the other, or of reduplication. Parallel instances may be cited among the placentals for either method of increasing the number of the teeth; but reduction from an original number of four or five is suggested by the fact that some of the Jurassic mammals display this number. But as the relations of these mammals are very doubtful and the oldest known marsupials show three or less, and the primary placental formula is certainly three, it appears simpler to assume an identical formula as above for the common ancestral stock of marsupials and placentals, the subsequent differences arising through the evolution of the second or replacing series of teeth and the partial suppression of the first series, additional incisors being acquired in some marsupials through reduplication.

However this may be, the fossil specimens allow of the recognition of molar and premolar teeth through their relative emergence. The first true molar is erupted with or shortly after the preceding milk molar, but before the successional premolar. The posterior molars are successively erupted after the first true molar. In consequence, the first true molar whether of a marsupial or a placental, is more completely emerged, and the base of the crown stands higher above the alveolar border than the premolar in front of it or the second true molar behind it. If the jaw were immature, and the last molar not yet or only partly erupted, one might suspect that the tooth occupying this position was a milk molar, but in the present instance the maturity and considerable wear of the teeth precludes this view. It appears to me beyond reasonable doubt therefore that the tooth formula in *Eodelphis* is as stated above.

hypoconulid is somewhat more separated from the entoconid. It is less damaged by corrosion than any of the other teeth, the enamel being nearly all preserved, and the points of the cusps intact except for the protoconid, which has lost the tip. The characteristic features are the short wide trigonid with paraconid and metaconid internal, distinct, but much closer together than in *Didelphis,* the paraconid somewhat higher than the metaconid, the protoconid external, anteroposteriorly compressed, somewhat lower apparently than the metaconid, certainly lower than paraconid, the large deeply basined heel with external hypoconid and posterointernal angle extended upward into a double cusp (entoconid-hypoconulid) decidedly higher than the hypoconid; the strong basal cingulum on the anteroexternal face of the trigonid rising sharply towards the high paraconid.

Compared with *Didelphis,* the paraconid is much higher, the trigonid shorter anteroposteriorly, the protoconid lower, the talonid of the last molar much larger and more like those of the preceding molars, all having the posterointernal angle more projecting and its cusps much higher.

The basal cingulum in *Didelphis* does not rise up so sharply towards the internal side. In general the trigonid of *Didelphis* comes much nearer to the carnivorous type, with high protoconid, paraconid projecting far forward, basin lower on the inner side, reduced and wedge-shaped talonid on m_3.

The characters of the lower molars in *Eodelphis* indicate that m^4 was not transverse as in *Didelphis* and that the metastyles of m^{1-3} were not extended into shearing crests.

The lower molar figured by Marsh as *Cimolestes curtus* is somewhat similar to the posterior molars of *Eodelphis* but the metaconid is more reduced, heel wider and shorter, its marginal cusps less differentiated and the posterointernal cusps not so high or backwardly prominent. The tooth is considerably larger, agreeing more nearly with *Thlæodon* in size.

Among modern polyprotodonts the exaggerated height of the inner cusps and reduction of the external row is carried much further in *Myrmecobius* in which the outer cusps of the lower molars have become vestigial, and correlatively the inner cusps of the upper teeth have almost wholly disappeared.

I do not find any near parallel among placental mammals to the molar construction of *Eodelphis.*

The *lower jaw* is shorter and more robust than in *Didelphis,* the anterior portion rising more abruptly to a stouter symphysis, the symphyseal suture about twice as long as wide. There is no trace of a meckelian groove. The posterior mental foramen is beneath m_1; the anterior mental foramen is larger, and situated beneath the anterior root of p_2. The dental foramen is larger than in *Didelphis* and considerably further forward, situated about half way between the last molar and the posterior border of the angle and slightly below the level of the alveolar line. The angle is much as in the opossum so far as preserved except that it is considerably broader, but the point of the angular process is broken off. The masseteric fossa is deeply excavated, more sharply defined anteriorly than in *Didelphis*, with prominent inferior border as in that genus.

The *jugal* is thin and of moderate width, the lower border comes to a thin edge with no trace of the broad flattened surface so characteristic of the opossum and many of its relatives.

The glenoid fossa is deep, broad, transversely extended more than in the opossum, and the postglenoid process about the same. The preglenoid process of the jugal is lost, but its broad triangular sutural union shows upon the surface of the squamosal, exactly as in the opossum. The anterior end of the jugal is broken off, but enough is preserved to show that the floor of the orbit was defined by a low ridge, partly on the posterior end of the maxillary and partly on the inner face of the jugal, somewhat better defined than in the opossum; the squamous suture of the maxillary with the jugal seems to be much the same save that the maxilla ends posteriorly in a broader plate. The posterior branch of the jugal is deeper than in the opossum although not so thick; its upper border in advance of the squamosal suture is defective, but apparently the zygomatic process of the squamosal did not

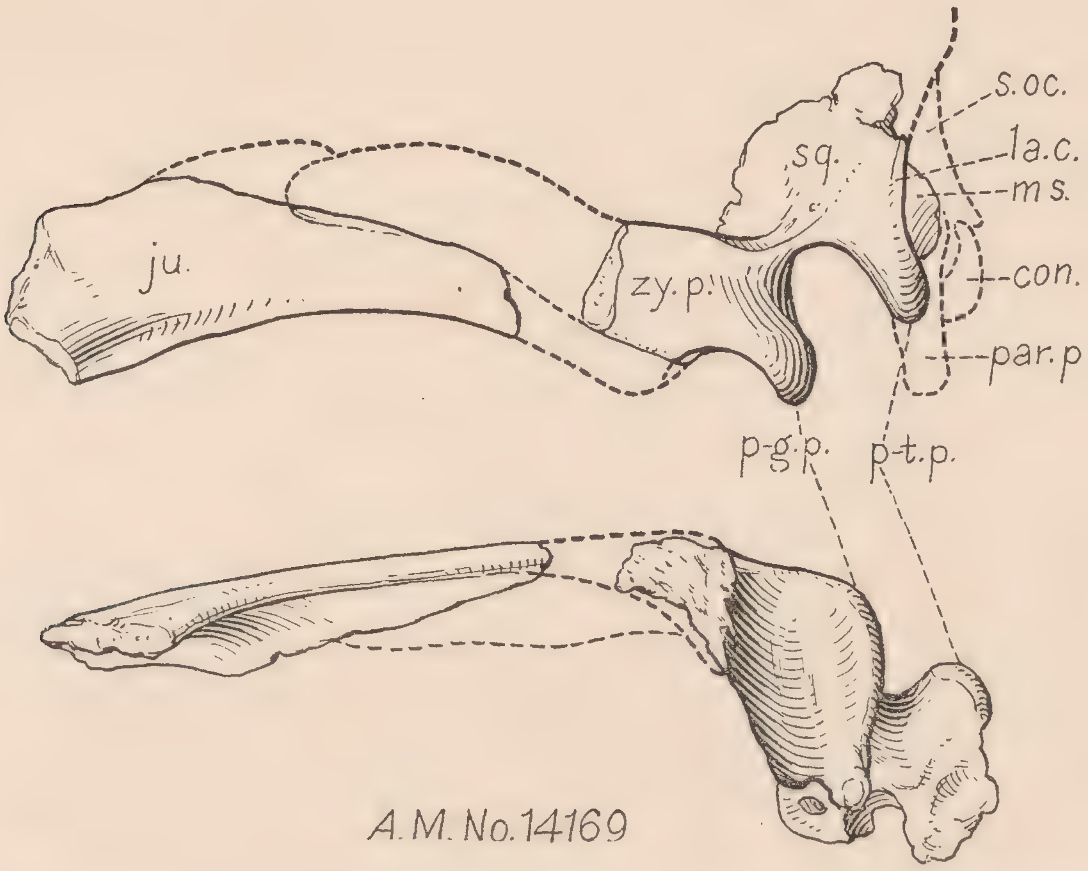

Fig. 2. *Eodelphis browni*, fragments of skull of type, side and under views, three halves natural size. The missing portions of the zygomatic arch and occipital region are partly restored in dotted outlines. Lettering as follows: *con.*, occipital condyle; *la.c.*, lambdoidal crest; *ju.*, jugal; *ms.*, mastoid portion of periotic; *par.p.*, paroccipital process; *p.–g.p.*, postglenoid process; *p.–t.p.*, posttympanic process; *s.oc.*, supraoccipital; *sq.*, squamosal; *zy.p.*, zygomatic process of squamosal.

extend so far forward, nor was the superior border of the jugal as high or as much extended over the inner face and superior border of the squamosal process.

Most of the *squamosal* bone is preserved. The glenoid fossa is somewhat wider than in *Didelphis;* the alisphenoid does not extend outwards along its anterior margin as in that genus, but ends abruptly at its inner border; a large diploë lies apparently between the alisphenoid and the glenoid portion of the squamosal, excavated in the latter bone above the inner end of the glenoid fossa.

The posttympanic process has the same general construction as in *Didelphis* but is more prominent and set further outward, its external margin nearly as far out as the middle of the glenoid fossa. This with the much wider mastoid exposure, the failure of the alisphenoid to extend out on the anterior border of the glenoid fossa, and the greater transverse width of the latter, all agree in indicating a decidedly wider occiput.

The postglenoid foramen is in the same relative position as in *Didelphis,* but somewhat smaller. There is no trace of the sub-squamosal foramen characteristic of most modern marsupials, but there is a minute postzygomatic foramen. The postglenoid foramen leads into an extensive series of canals and diploës whose relations cannot be wholly distinguished owing to the breaking away of the bone which has exposed them.

The *mastoid* portion of the periotic is nearly complete but the petrosal portion is almost wholly broken away. The occipital exposure of the mastoid is remarkably wide and compares well with *Sarcophilus;* in *Didelphis* and most other polyprotodonts it is only about half this width. The mastoid foramen is conspicuous, opening downward and forward into the system of canals and sinuses between the squamosal and periotic. The anterior surface of the mastoid directly mediad to the posttympanic crest is grooved by the stylomastoid foramen, and mediad to this is a rather large fossa excavated in the anterior face of the mastoid, apparently the posterior end of the mesotympanic pit. A third fossa larger and deeper than the preceding lies above the broken off petrosal and agrees fairly well in size and relations with the corresponding diploë in *Phascologale;* in the carnivorous marsupials this diploë appears to be filled up with cancellous tissue.

Comparisons. The only Belly River mammals as yet described are *Ptilodus primævus* Lambe and *Boreodon matutinus* Lambe. The first is known from a fragment of a lower jaw with two well preserved teeth, and is clearly a plagiaulacid. *Boreodon* is known only from an imperfect premolar tooth, and although described by Lambe under Plagiaulacidæ the figure agrees rather with the Trituberculata. It is practically an indeterminate type, and Mr. Lambe has wisely made no attempt to estimate its affinities.

The tooth may well be a lower premolar of a relative of *Thlæodon;* but it does not agree at all closely with the premolars of the new genus so far as comparison can be made and is larger and more robust. Mr. Lambe notes a concavity on the posteroexternal and posterointernal faces of the tooth, separated by a median posterior crest; and no such form is indicated in our specimen.

Among the various lower molars of tritubercular type figured by Marsh, those referred to *Didelphops* and *Cimolestes* agree most nearly with the present genus in the comparatively low protoconid, short wide trigonid and large talonid. In other figured types the protoconid is higher, paraconid more extended anteriorly, talonid smaller. Most of these are referred specimens of very questionable correlation. The type of *Didelphops vorax* is an upper molar. The type of *D. ferox* is a lower molar of which Marsh states that "its crown has the same general composition as that of the lower molars of the modern *Didelphys* but the anterior portion is more elevated." His figure whether intended as an inner or an outer view does not at all agree with this description; nor do either figure or description accord with the lower molars of *Eodelphis.* The type of *D. comptus* is a lower molar whose "structure is well shown in the cuts mentioned. There is a characteristic ridge on the outer surface but not on the inner." If Marsh's figure is correct this tooth pertains to an animal certainly not congeneric with the preceding species, nor with *Eodelphis.*

The type of *Cimolestes, C. curtus,* is also based upon an isolated lower molar which agrees more nearly with *Eodelphis,* the principal difference being the smaller metaconid, shorter and wider heel with no distinct marginal cusps and lower internal and higher external border. The type of *Cimolestes incisus* on the other hand is a molar of quite different proportions, much more like those of *Didelphis.*

Why Marsh associated such widely different types of teeth in the same genus, or what he could possibly have supposed to be the distinctive generic characters of the two genera cited I do not know. At all events the jaw here described differs so much from any of the types figured that it cannot be referred to *Didelphops* or *Cimolestes,* and is still more distinct from *Stagodon.*

The type of *Pediomys* is another upper molar, probably a last molar, and incommensurable.

The type of *Telacodon* is the anterior part of a lower jaw, slender anteriorly and with small front teeth, of quite different type from *Eodelphis.*

III. Re-description of Thlæodon padanicus Cope.

The type is a lower jaw with part of the upper jaw, No. 3013, Amer. Museum Cope Coll., found by J. L. Wortman in the Lance beds of South Dakota. It is the only one of the trituberculates from the Lance that is based on an adequate type. Some, but not all, of the teeth and fragments included by Marsh under *Stagodon* are probably congeneric with Cope's type; and the upper molar on which *Didelphops* was founded, *D. vorax* Marsh, is very like the upper molars of *Thlæodon* and may also be congeneric; while the lower molar on which *Cimolestes* rests accords equally well with the lower molar of *Thlæodon.* But most of the referred species of each of Marsh's three genera are certainly not congeneric with the genus here described.

The type represented by this genus is a very peculiar one. Marsh compares it (*Stagodon*) with the modern *Sarcophilus,* and there is in fact a certain degree of resemblance in the stout robust proportions of the jaw. But in *Sarcophilus* the molars are large powerful shearing teeth, and the premolars greatly reduced, while in the *Thlæodon* group the premolars are greatly enlarged robust crushing teeth, the molars reduced, 'insectivorous' in type. The relations between *Thlæodon* and *Eodelphis* are in some respects parallel to the relations between *Sarcophilus* and *Dasyurus,* although the diversity is less between the two Cretaceous than between the two modern genera. But the specialization of *Thlæodon* is in a wholly diverse adaptive direction from *Sarcophilus.*

The type of *T. padanicus* has never been photographed, and Cope's figure of it is very crude. His description is an extended one, but requires amendment in several important particulars, as it is based upon an incorrect interpretation of the specimen.

Cope states that the upper and lower jaw were found (by Doctor Wortman, 1888–1890?) about 100 feet apart but correspond so closely in character and wear that they may be referred safely to the same species and probably to the same individual. Unfortunately no details have been preserved of the exact circumstances of the discovery. So far as the preservation, wear and fit of the jaws are concerned they have every appearance of belonging to the same individual. Cope gives the tooth formula of the lower jaw as $\overline{?.1.4.\ ?3.}$ I think it more probably interpreted as $\overline{?.1.3.\ ?4.}$ There is a large canine alveolus and behind it two long slender divergent alveoli, one posterointernal the other posteroexternal to the canine alveolus, probably for two-rooted p_1. Following are two transversely wide roots crowded together, which Cope considers as roots of p_2 and p_3, the crowns being completely worn off. Each of these roots corresponds in position and form to the double root of p_1 and may be similarly divided into two distinct roots below the alveolar border, although certainly not so divergent. I think it most probable that these are the anterior and posterior roots or pairs of roots of a single robust premolar of similar type to the one that follows, but wider and shorter. The last premolar is a very robust 'inflated' tooth, the bulbous crown simple save for indications of a rudimentary heel, and worn flat at the top. Marsh's figure of '*Stagodon*' *validus*, which seems to be allied to *Thlæodon* although not identical with *T. padanicus*, shows three premolars behind the stout canine, the first very small, the second large, robust, and, although incomplete, apparently corresponding to the two roots or pairs of roots of *Thlæodon padanicus*, and the third evidently corresponding with the last premolar of Cope's type although differing in proportions. This is the natural derivative of the primitive proportions of the premolars observed in *Eodelphis*, and more or less characteristic of all polyprotodont marsupials; the first premolar is small and short, often one-rooted, the second and third much larger,

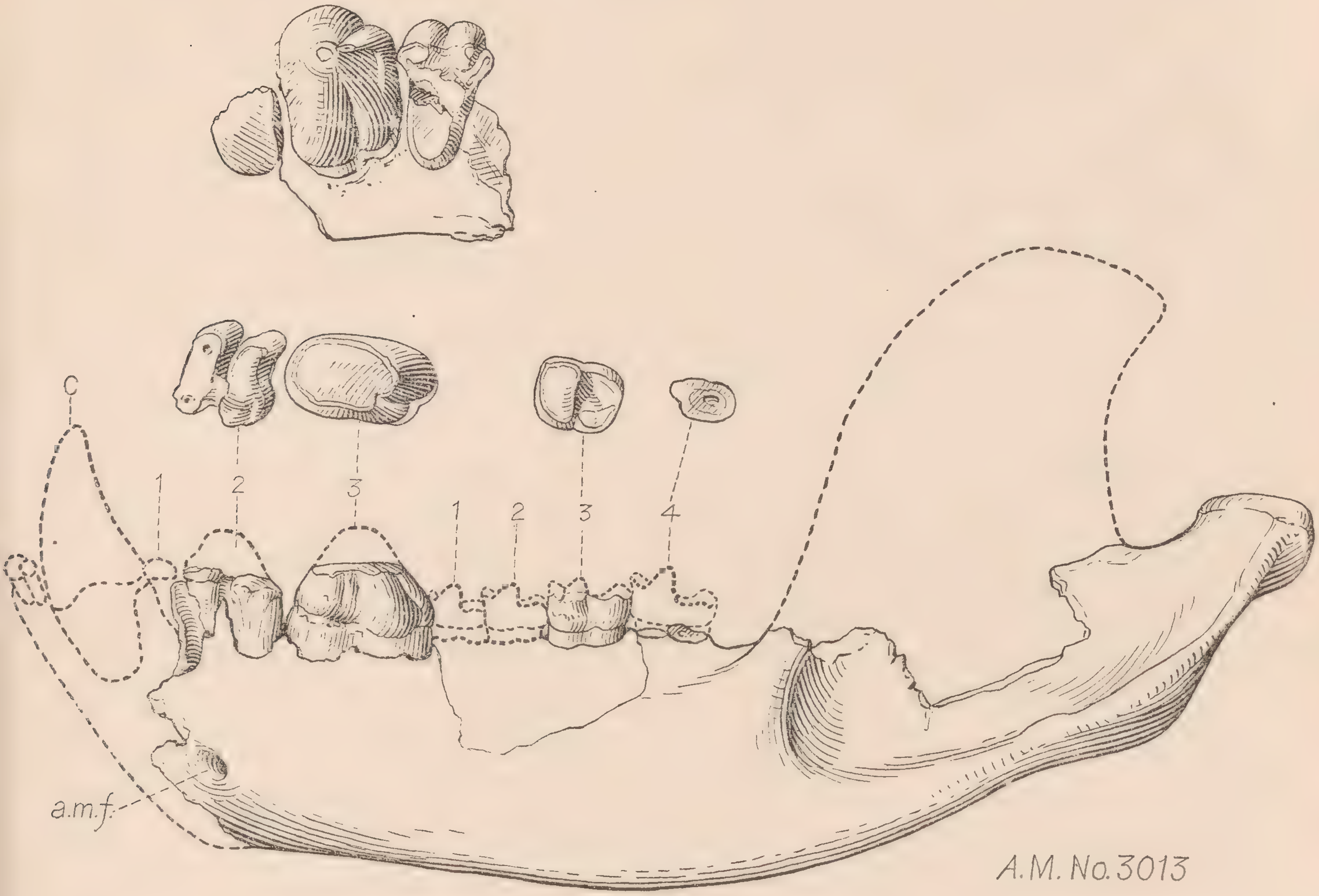

Fig. 3. *Thlæodon padanicus*, upper jaw fragment, lower jaw and crown view of lower teeth, type specimen, No. 3013, three halves natural size: *a.m.f.*, anterior mental foramen.

two-rooted and subequal. The broadening of the premolars would result in giving p_1 a transversely broadened root or pair of roots internal and external, and p_2 and p_3 would each have two transversely broadened roots or pairs of roots. Cope's interpretation would involve very anomalous proportions in the premolars, comparable indeed to some of the Epanorthidæ, but not to any of its near allies *Stagodon, Eodelphis* etc., nor to the didelphids.

The alveolar borders of the jaw are missing behind the last premolar, as far as the posterior root of the last molar, which is round oval and of moderate size. The crown of an intermediate molar is preserved nearly complete, but cannot be certainly placed in the jaw so that the number of molars is uncertain. The pattern of the tooth is very like that figured by Marsh as the type of *Cimolestes curtus,* but it is much more worn. The space appears to me adequate for accommodation of four molars, of which the first would be somewhat smaller than the others, and this I regard as the probable arrangement in view of the obvious marsupial characters of the jaw.

The back of the jaw including the condyle is largely present and accords very well with marsupial jaws of similar robust proportions, although not so specialized as in *Sarcophilus*. It has apparently the usual inflected angle, but the inflected border is mostly broken off; on the outer side the masseteric fossa is deep and bounded inferiorly by a strong crest. Cope's statement that the jaw has no angular process is due apparently to his failure to observe that the inner angular border is a broken edge. There is in fact no reason to believe that the angle differed in any way from the normal polyprotodont type. The condyle is wide transversely, and strongly rolled. The anterior part of the jaw is of moderate depth but very short and robust; the symphysis is not preserved, nor anything in advance of the posterior side of the canine alveolus. The mental foramen is large, situated under the first and second premolars.

The upper jaw fragment and teeth I interpret differently from Professor Cope. It appears to be a fragment of the left, not of the right maxilla. A portion of the floor of the orbit is present, and the relations and slope of this, its continuance with the external surface of the maxilla, seem to show clearly that Professor Cope mistook the anterior for the posterior end of the maxilla. The single complete tooth I agree with him in identifying as p^4, but the inner halves of the teeth adjoining it on each side will, according to this arrangement, be p^3 and m^1, instead of m^1 and p^3; and the outer half of an unmistakable molar tooth which clearly does not conform to the tooth identified by him as m^1, and was hence identified as m^2, conforms very well to the missing outer half of the tooth supposed by Cope to be p^3 but which must be m¹ with the jaw reversed. I can find no actual contact between this tooth and the main portion of the jaw; possibly it is not m¹ but m² or m³, but the amount of wear, size and proportions, lead me to conclude that it probably belongs as here placed.

This arrangement is not only more in conformity with the details of construction, proportions and wear in the upper teeth, but it is also more in accord with the probabilities of preservation and discovery in the field. It is reasonably certain that both the lower jaw and the maxillary fragment are from the left side, and as thus placed the maxilla conforms so well in position and wear of the teeth with the lower jaw as to make it almost certain that they are from the same individual. It is more probable that the external half molar lying beside the upper jaw fragment should be the missing outer half of the molar whose inner half is still in place than that it should be part of another molar entirely beyond the limits of the portion of the maxilla preserved; and if, as is not unlikely, the maxilla was originally in place on the mandible, the process of erosion which removed the front of the maxilla and mandible, the upper and lower molars, would spare until the last the posterior premolar and anterior molar teeth. Subsequently, one may suppose, the maxillary fragment became separated and rolled down a slope perhaps, to the considerable distance where it was found.

The penultimate premolar, as here understood, is represented by the much worn inner half, and was presumably a wide bulbous tooth, subquadrate, wider than long, moderately large, but much smaller than its neighbor. The last premolar is much larger than its neighbors, bulbous, globular, rounded, quadrate in outline, divided by transverse radial furrows into a larger anterior and much smaller posterior segment, each again obscurely divided into inner and outer quadrants. It has three stout roots, posterior, internal and anteroexternal in position.

The first molar is a transversely extended tooth roughly trilateral in outline, nearly as wide transversely as the preceding tooth but shorter anteroposteriorly. The construction of the tooth seems, so far as it is preserved, to be much as in *Didelphops* Marsh or *Ectoconodon* Osborn, but wider transversely than Osborn's type. The styles are developed into a pair of robust powerful cusps strongly convex externally; a sharp short cingular crest runs inwardly from the posteroexternal angle, and internal to these lies a worn transverse ridge apparently the remains of paracone and metacone. The protocone is also worn down almost to the base of the crown, and no indications remain of internal cingula; the middle portion of the tooth is missing and the conules if they existed are not shown. The constructional resemblances in the outer part of the tooth to *Didelphops* are sufficient to make it highly probable that the whole tooth was similarly constructed. It has one internal and two external roots, subequal, moderately compressed anteroposteriorly, the outer pair parallel and moderately divergent from the inner root.

There are no traces of roots or alveoli of molars behind m^1 but the specimen is broken in such a way that if present they would be wholly destroyed, and the number and size of the lower molars make it safe to infer three or four upper molars of moderate size.

It is not at all improbable that *Didelphops ferox, D. comptus, Cimolestes curtus,* and perhaps others of Marsh's Lance mammal species may be based on isolated teeth of *Thlæodon. Stagodon validus* is based on the anterior portion of the jaw of a related species, possibly congeneric. But it would be a waste of time to attempt detailed comparisons on the present data; Marsh's genera are arbitrary assemblages of teeth which evidently were not carefully studied or compared by the describer, the descriptions, when there are any, are of no value and so discrepant from the illustrations as to throw doubt on their accuracy.

Affinities of the Cretaceous trituberculates. It is possible — I do not think it probable — that a prolonged and exhaustive research upon the three Lance collections — one at Yale University, one at the American Museum, the third at the National Museum — might result in a really sound and reliable placing of the teeth and classification of all the alleged genera of Cretaceous trituberculates. At present two genuine and determinate types emerge from the miscellaneous ruck of odd teeth and jaw fragments. These are *Thlæodon* of the Lance and *Eodelphis* of the Belly River. So far as one may judge from the fragmentary material, *Thlæodon* is an extreme of a type characterized by large size, short jaws, enlarged robust premolars, low tritubercular molars. *Eodelphis* is a somewhat central type, with various intermediates between it and the *Thlæodon* specialization, while on the other side there are several small slender-jawed genera with insectivorous molars either paralleling the smaller Didelphids or perhaps approaching the Epanorthid specializations. All these may be grouped in one family Cimolestidæ provisionally, and there are really no wholly conclusive reasons at present for separating them from the Didelphidæ. Apparently there is more or less reduction and differentiation of the incisors in most or all of the genera; but this by itself is a slender basis for family distinction. The difference in character of teeth between *Thlæodon* and the small insectivorous types is not greater than between the sea-otter and the weasels or between *Dasyurus* and *Sarcophilus* if a marsupial comparison be demanded; the number of premolars is a character whose taxonomic value in Cretaceous marsupials is unknown, and the evidence for more than three in any of them is a matter of very doubtful interpretation of alveoli — too shaky a foundation to build permanent systematic results upon it.[1] The alveoli which Marsh identified as canines in *Batodon* and *Telacodon* may quite as well be enlarged incisors. If this be the case these genera were analogous, or possibly related, to the Epanorthidæ and may not have been so closely related to *Eodelphis* and its allies.

The tendency to reduction and specialization of the incisors observed in *Eodelphis,* and perhaps carried further and accompanied by a reduction of the canine in such types as *Telacodon* and *Batodon,* is suggestive of the conditions found in the diprotodont marsupials, and especially in the pseudo-diprotodonts of South America. This cannot be assigned much weight as evidence of relationship until it is shown to be correlated with a tendency towards the peculiar specialization of the posterior premolars characteristic of the cænolestid group (Epanorthidæ), and of this there is at present no

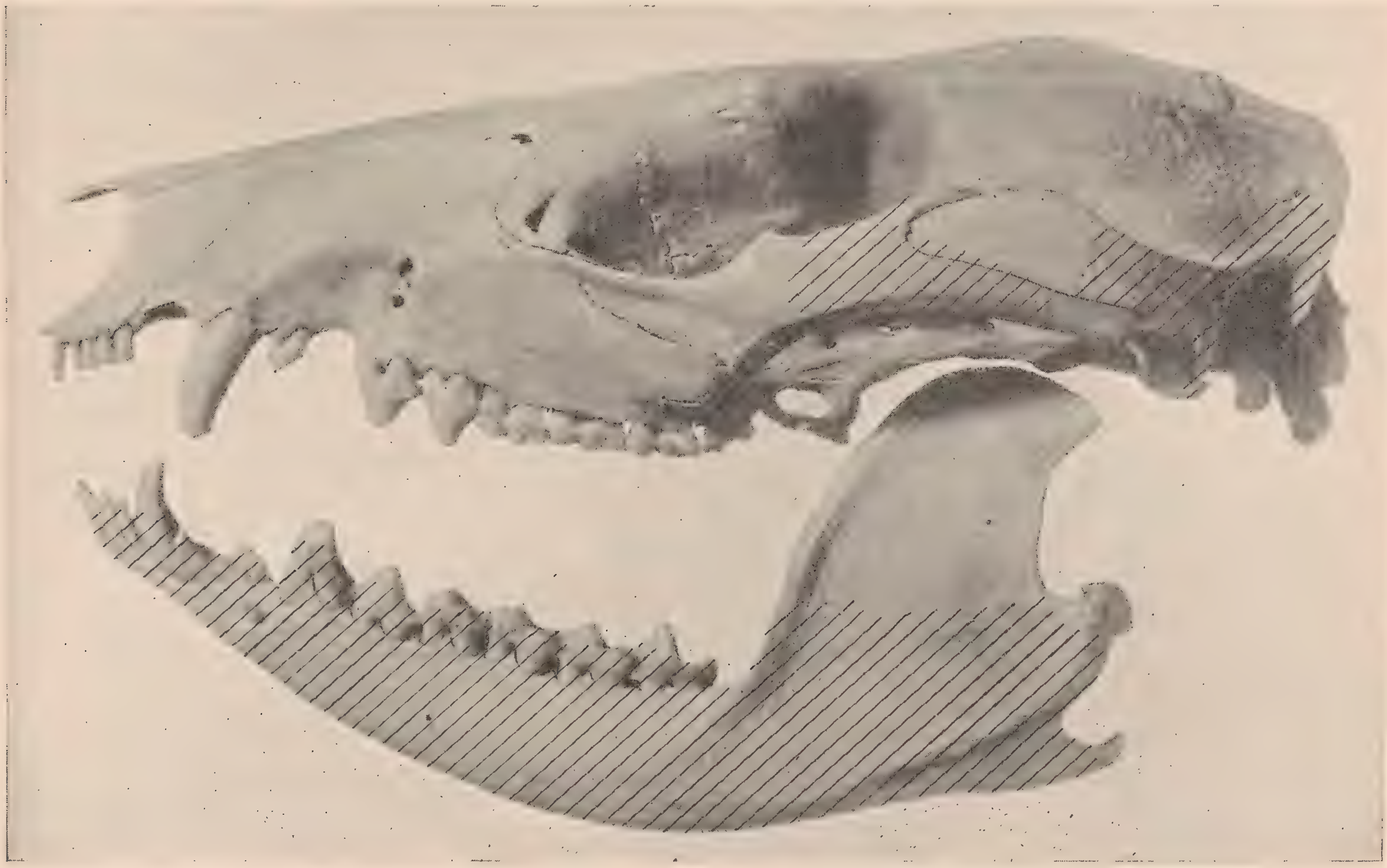

Fig. 4. *Didelphis virginiana*, skull and lower jaw, three-halves natural size, the cross-hatching showing the parts preserved in *Eodelphis browni* type.

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[1] It has of course an important bearing upon the evolution of mammalian dentition. For that reason if no other it seems necessary to insist that the supposed four or five premolars in some of these Cretaceous mammals is not a proven fact like the marsupial characters of their jaws and teeth, but a doubtful interpretation. Theoretical discussions of evolution in this as in other subjects are very apt to confuse between certainties and probabilities. One may build safely upon the former, but not upon the latter; their relative value in controversial questions is very different.

evidence. (The quadrate molars of the cænolestids might well be a later adaptation, hardly to be expected in the Lance). One may likewise observe among the isolated molars of the Lance, types which appear to be tending towards the shearing specializations of the Borhyænidæ, Dasyures and Thylacines. But until a sound and positive correlation of these isolated teeth can be made, it is idle to discuss any special affinities of this sort.

In his very valuable detailed study of the stratigraphic position of the mammal localities in the Lance formation, Professor Lull[1] has observed that while the Multituberculates range throughout the formation from top to bottom, the Trituberculates are absent from the lowermost levels. He appears to attach considerable importance to this circumstance, and observes "This seems to be significant, for Multituberculates are known from the Jurassic and become extinct in the Paleocene, while descendants of the Trituberculates may still exist." Whatever views may be held as to the relationship of the Lance trituberculates to Tertiary and modern mammals, it is evident that their absence from the lowest levels of the formation cannot be ascribed to other than local conditions, since multituberculates and trituberculates both nearly allied to the Lance genera occur in the much older Belly River formation.

IV. CONCLUSIONS.

The specimen here described is the most complete fossil mammal yet discovered in the Cretaceous. Its Cretaceous age is unquestionable, and its affinity to the Didelphidæ unmistakable. It is nearly related to some of the trituberculate mammals of the Lance formation and is considered to be a new genus and species of Cimolestidæ, a family not clearly separable from Didelphidæ. It agrees in the number and characters of the premolar and molar teeth, the construction of the angle of the jaw, zygomatic arch and temporal region of the skull, and differs only in the reduction and specialization of the incisor teeth.

A re-examination of *Thlæodon padanicus* Cope from the Lance formation shows that serious errors in the description and interpretation of this type have been made. Although peculiarly specialized in the premolars it is quite nearly related to *Eodelphis* and derivable from a similar type. It agrees with *Eodelphis* in the characters of the angular region of the jaw, and probably in the premolar and molar formula, but the incisors may be further reduced, and the premolars are enlarged and much inflated and the jaw more robust throughout.

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[1] Lull, 1915. The Mammals and Horned Dinosaurs of the Lance Formation of Niobrara County, Wyoming. Amer. Journ. Sci., Vol. XL, p. 316.

Eodelphis, Thlæodon, and all the more fragmentary trituberculates of the Cretaceous may well belong to a single family Cimolestidæ, of which the Didelphidæ represent the little-altered descendants. The Epanorthidæ and Borhyænidæ of the South American Tertiary may be considered as divergent specializations from the same stock, evolved in the New World but probably chiefly in South America, while the Diprotodonts, Phalangers, Dasyures and Thylacines whose relations to the Cimolestidæ are more distant may represent parallel Old World specializations, probably evolved chiefly in Australia, and ultimately derived from Palæarctic Cretaceous marsupials very similar to the American Cimolestidæ and probably to be included, when found, in the same family.

As thus interpreted, the marsupials, more or less cosmopolitan in the Cretaceous, were displaced from the northern world by the placentals at the great diastrophic epoch that closed that period, and found a refuge in the two great southern continents, Australasia and South America. During the Tertiary while the placentals were evolving and dispersing from Holarctica, the marsupials underwent a corresponding adaptive radiation and dispersal from the two isolated southern centres towards the tropical regions. The remnants of those dispersals we find in the later Tertiary and Pleistocene and modern faunas of the southern and tropical regions; in each, the most primitive surviving types are found in the tropics, the most specialized types far to the southward, since the dispersal movement was conditioned by the progressively cold polar climates. The parallelism between the specializations of the two isolated southern dispersal centers is rather striking, diprotodonts and thylacines evolving from phalangers in the one, pseudo-diprotodonts and pseudo-thylacines evolving from opossums in the other. It is only by the more careful anatomical studies of recent years that the superficial and purely adaptive character of these resemblances has been perceived. Much more work in this line will be needed in order to demonstrate conclusively their exact affinities; the foregoing conclusions must be regarded merely as a tentative interpretation of the evidence at hand.

DESCRIPTIONS OF PLATES II–VI.

Plate II.

Eodelphis browni, type. Figs. 1–3, lower jaw, twice natural size, external, superior and internal views. Fig. 4, 4a, stereoscopic view of front of lower jaw, four times natural size.

Plate III.

See description under Plate IV.

Plates III and IV.

Eodelphis browni, type, zygomatic and temporal portions of skull, twice natural size, with corresponding views of the temporal region of *Didelphis virginiana* introduced for comparison.

Fig. 1. *Eodelphis*, internal view of jugal showing small portion of maxillary attached.

Figs. 2, 3, 4. *Eodelphis*, jugal and temporal regions, superior external and inferior views; 2a, 3a, 4a, corresponding views of temporal region of *Didelphis*.

Fig. 5. *Eodelphis;* 5a, *Didelphis*, posterior views of temporal showing relative extent of mastoid exposure.

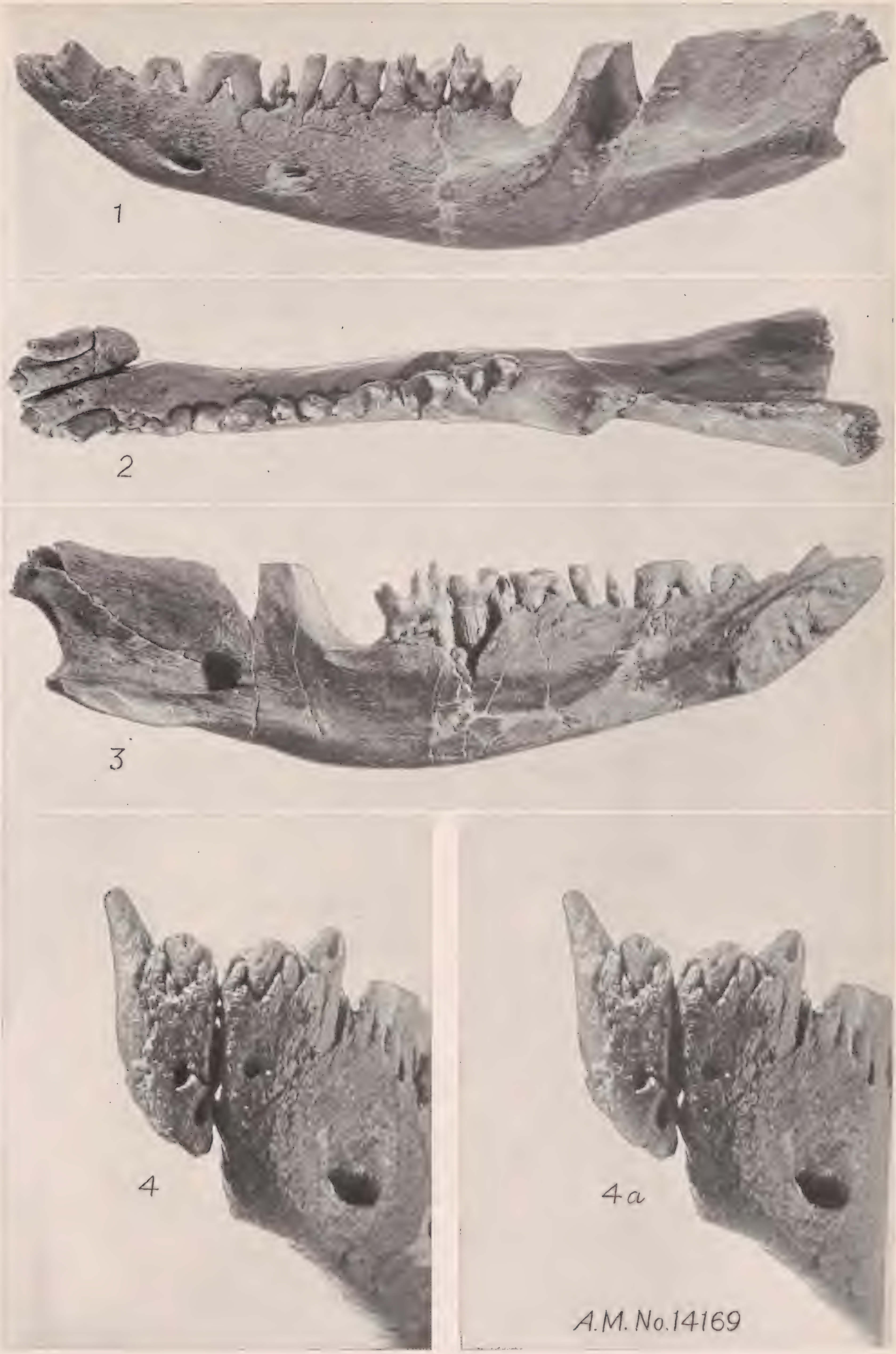
Fig. 6. *Eodelphis*, lower jaw of type, posterior view, showing inflection of angle.

Plate V.

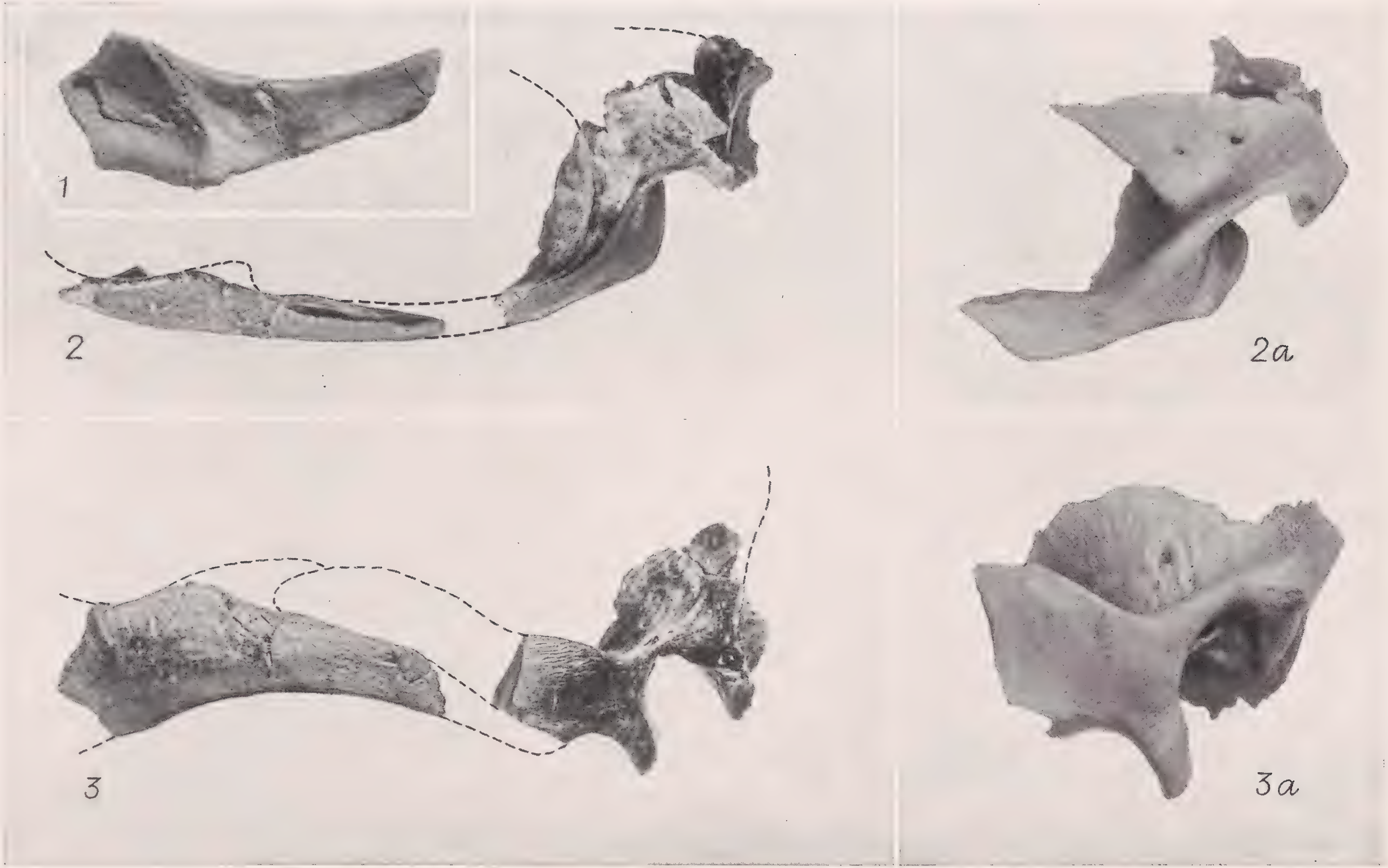
See description under Plate VI.

Plates V and VI.

Thlæodon padanicus, type, lower jaw and upper jaw fragment, twice natural size. Figs. 1, 2, 3, superior internal and external views of lower jaw; Figs. 4, 5, 6, external palatal and internal views of fragment of upper jaw.



EODELPHIS BROWNI. Type.



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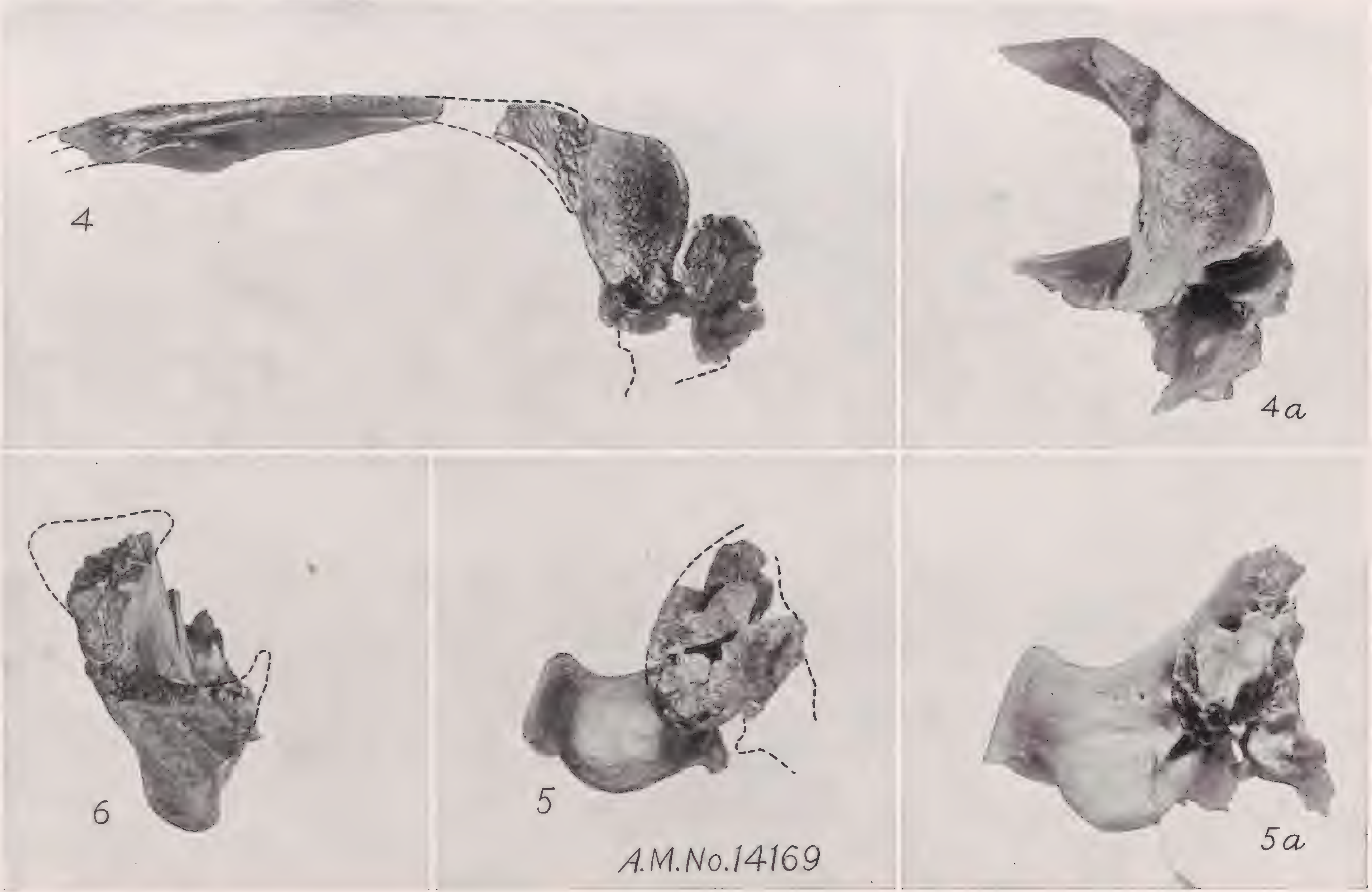

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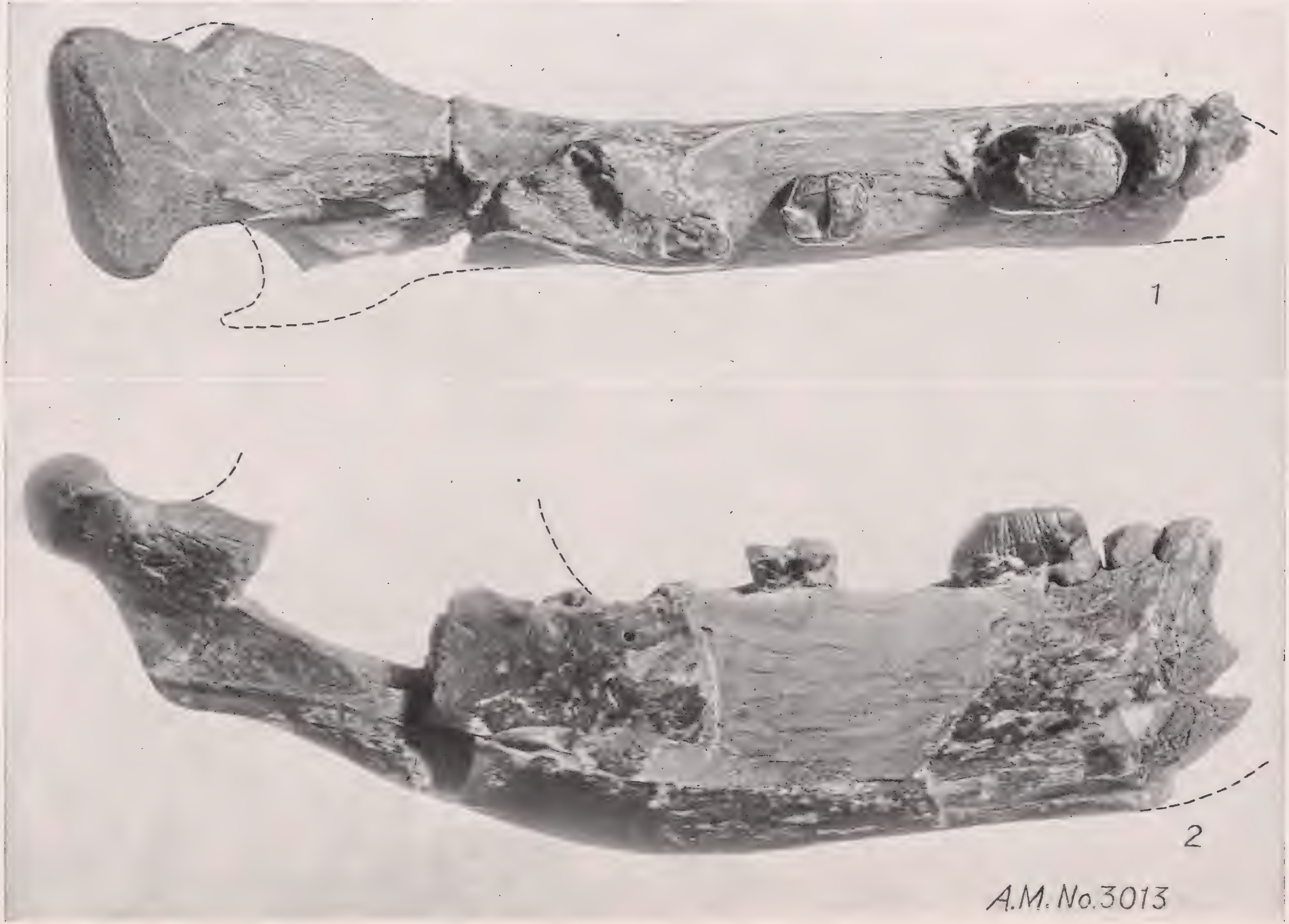
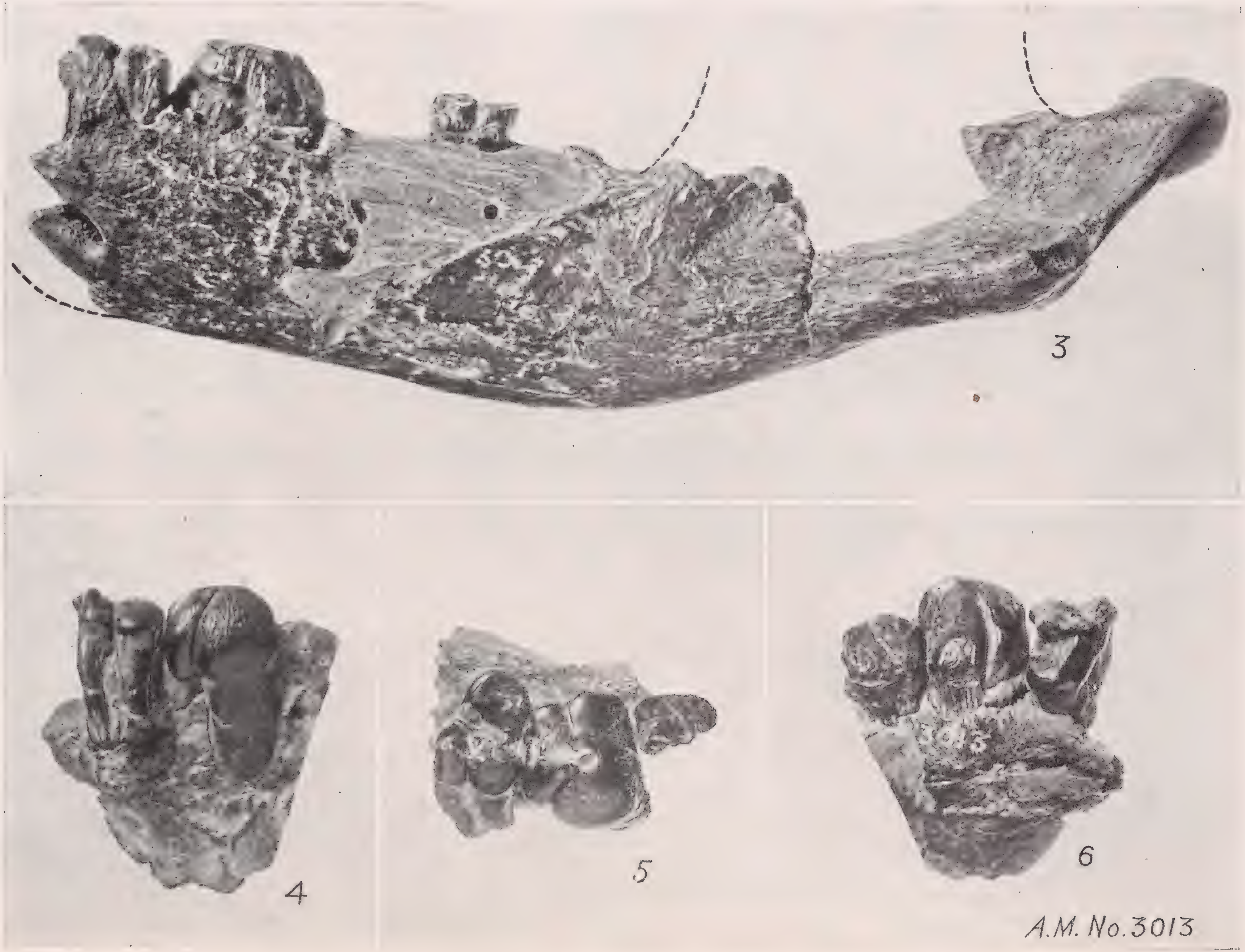


THLÆODON PADANICUS. Type.



Thlæodon padanicus. Type.

59.57, 99B

Article XXVI. — THE GEOGRAPHIC DISTRIBUTION OF BOMBIDÆ (HYMENOPTERA), WITH NOTES ON CERTAIN SPECIES OF BOREAL AMERICA.

By Frank E. Lutz.

The fauna of boreal America is interesting not only because of its ability to withstand severe and prolonged cold but because of its bearing upon the problem of the origin of the entire American fauna. If it be true that the fauna of the warmer parts of America has been derived by successive waves of migration from the polar regions, the climate there having been, at times, milder than it is now and the path between Asia and Alaska fairly open, the present-day fauna of the boreal region may be considered to be one which has largely displaced its predecessors. Such of these predecessors as are now living are, for the most part, to be found in milder climates. Two reasons have been suggested for this movement: it may be that the older forms were adapted to the environmental complex which accompanies a milder climate and for this reason changed their range as the climate changed or it may be that there was an animate *vis a tergo,* the new forms actually driving the old out by competition. The effect would be much the same. Some of the species now found in the boreal region are doubtless remnants — representatives of groups which were formerly dominant there — and some are the result of eddies or tides in the southward-flowing stream of faunal migration — forms which have come in to help populate a region now more habitable than it was in the immediate past — so that the case is not so clearly defined as one might wish but it ought to be possible, by a study of distribution of the boreal and related species, to gather hints concerning the history of the faunal movements in America. Unfortunately, in the case of insects, sufficient direct paleontological evidence is not available for a definite decision.

The bumble bees (Bombidæ) have been selected in this case partly because we have a good monograph[1] of the American species and partly because it is generally believed that the family is of relatively recent origin. The first reason is of practical importance and the second is important to the discussion of theory. If a group is of recent origin we are fairly certain that it is nearly the culmination of its particular line. On the other hand a group which is of ancient origin may or may not be the latest that its line has produced.

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[1] Franklin, H. J. 1913. 'The Bombidæ of the New World.' Trans. Amer. Ent. Soc., XXXVIII, pp. 177–486; XXXIX, pp. 73–200.

For some reason, possibly because it is still actively evolving or possibly because the chips formed in the process of making species have not yet been cleared away, the Bombidæ are very difficult taxonomically. Many of the species were founded only on the color of the pilosity and, in fact, subgenera have also been proposed with color as the chief distinguishing characteristic. The only excuse for such subgenera is that they are of some help in identification. Variability in color is astonishingly great in certain species and is to be looked for in most of them. On the other hand, structural distinctions between species are usually slight and difficult to describe.

The Psithyridæ are Bombidæ which largely, or altogether, lack the habit of making nests and gathering pollen. In correlation with the lack of the pollen-gathering habit, the Psithyridæ do not have either corbiculæ or "pollen mills." Their eyes are smaller and their hind metatarsi narrower than those of their more industrious relatives. Further differences are the largely toothless mandibles, the lateral elevations on the female hypopygium, and the volsellæ of the male genitalia membranous (instead of corneus) with the apical projections absent. There is little doubt that the Psithyridæ are closely related to and have been derived from the Bombidæ by "degeneration." Giving a separate family name to them or classifying them with *Bombus* are merely matters of convenience and both plans are in good usage. They are not considered in this paper.

Two main divisions of American Bombidæ, in the narrow sense, are recognized: *Bombus* and *Bombias*. These are sometimes given generic rank but the distinctions are slight and they are more generally considered as subgenera of *Bombus* while Franklin (1913) believes that "the name *Bombias* should be entirely suppressed." This is not the time or place to discuss the relative advantages of the two arrangements and, furthermore, the Old World species have not been divided in this way so that we are, as yet, unable to bring them into line. In *Bombias* the ocelli are larger and placed lower, relative to the upper margins of the eyes, than in *Bombus;* the eyes of male *Bombias* are more bulging; the apices of the hind metatarsi of the female are usually not drawn out into so prominent and acute a projection, behind the insertion of the second tarsal segment; the malar space is usually shorter than its width at the apex; the volsellæ of the male genitalia are long and hind metatarsi of this sex are furnished with long hind fringes.

Franklin (1913) has divided the American species of *Bombus* into seven "groups": *Fraternus, Auricomus, Dumoucheli, Pratorum, Kirbyellus, Borealis* and *Terrestris.* The first two are divisions of *Bombias* and the rest of *Bombus* in the narrow sense. The divisions follow, to a great extent, those of *Radoszkowski*[1] who was a pioneer in the application of a study of the genitalia to the taxonomy of these bees. Because of the relative inaccessibility of his paper, as well as because of the bearing of this grouping upon the present discussion, I list here the species as divided by Radoszkowski, not changing the synonymy.

1. The group of *B. pratorum* L.
   - *B. pratorum* L.
   - *B. consobrinus* D.
   - *B. hypnorum* L.
   - *B. lapponicus* F.
   - *B. alticola* K.
   - *B. modestus* E.
   - *B. ussurensis* R.
   - *B. pyrenaica* P.
   - *B. scrimshiranus* K.
   - *B. hæmaturus* K.
2. The group of *B. lapidarius* L.
   - *B. lapidarius* L.
   - *B. lefevrei* Lep.
   - *B. sicheli* Rad.
   - *B. niveatus* Krich.
   - *B. caucasicus* Rad.
   - *B. eriophorus* Bib.
3. The group of *B. wurfleini* Rad.
   - *B. wurfleini* Rad.
   - *B. mastrucatus* Gerst.
   - *B. vorticosus* Gerst.
   - *B. eximius* Smit.
4. The group of *B. derhamellus* Kirb.
   - *B. derhamellus* Kir.
   - *B. viduus* Erich.
   - *B. balteatus* Dlb.
   - *B. dagestanicus* Rad.
   - *B. baicalensis* Rad.
   - *B. muscorum* L.
5. The group of *B. canus* Pall.
   - *B. canus* Pal.
   - *B. pomorum* Poz.
   - *B. mesomelas* Ger.
6. The group of *B. sylvarum* L.
   - *B. sylvarum* L.
   - *B. equestris* F.
   - *B. mlokoscwitzi* Rad.
7. The group of *B. tristis* Seidl.
   - *B. tristis* Seidl.
   - *B. insipidus* Rad.
8. The group of *B. fervidus* F.
   - *B. fervidus* F.
   - *B. subterraneus* L.
   - *B. distinguendus* M.
9. The group of *B. dumoucheli* Rad.
   - *B. dumoucheli* Rad.
   - *B. chilensis* Spil.
   - *B. thoracicus* Sich.
10. The group of *B. terrestris* L.
   - *B. terrestris* L.
   - *B. fairmairi* Sich.
   - *B. portchinski* R.
   - *B. renardi* Rad.
11. The group of *B. sorœensis* F.
   - *B. sorœensis* F.
   - *B. perplexus* Rad.

It should be remembered that this was pioneer work, the author himself adding to the list in 1883[2] and making certain corrections, notably that the *viduus* of his 1884 paper was a misidentification. Furthermore it is, for the most part, concerned only with European species. However, *chilensis*

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[1] Radoszkowski, O. 1884. 'Révision des armures copulatrices des males du genre *Bombus*.' Bull. Soc. Imp. Nat. Moscou, LIX, pp. 51–92.

[2] Radoszkowski, O. 1888. 'Etudes Hyménoptèrologiques. I. Révision des armures copulatrices des mâles.' Horæ Soc. Ent. Rossicæ, XXII, pp. 315–323.

Table 1. *Certain distinguishing characteristics of the various American groups of Bombus.*

	Dumoucheli	*Pratorum*
♀ Head	elongate triangular	variable but usually distinctly triangular
♀ Malar space	of good length	usually of fully average length
♀ Mandibles	distinctly 3-toothed	as in *Dumoucheli*
♀ Hypopygium	without median carina	usually without median carina
♀ Pile	rather coarse and of medium length	medium to long, of variable texture
♂ Antennæ	long and slender	of not more than average length
♂ Corbiculæ	very slight or absent; little or no hair	more or less strong; long hairs
♂ Outer surface of Posterior tibiæ	distinctly convex	usually at least slightly convex
♂ Hind metatarsi	bearing no long hair	with posterior fringe variable, never very short and in most species rather long
♂ Claspers	thick and powerful, rather short; branches very wide at base and narrowing very rapidly toward the apical portion	rather slender and weak; apex of each branch broadly rounded, its inner side, in most cases, more or less pointed
♂ Volsella	very broad and thick with long triangular recurved apical projection	long and slender, usually of about the same width throughout except at the base where it is, in most cases, rather suddenly wider
♂ Squama	usually with a very prominent inner lobe, this usually being elongate in form and widened and rounded at the end	triangular in outline, the inner lobe being vestigial or absent

Table 1 (*continued*).

Kirbyellus	*Borealis*	*Terrestris*
very long triangular	triangular	broad and rounded
reaching its maximum length	long	short
as in *Dumoucheli*	as in *Dumoucheli*	strongly 4-toothed
without median carina	with median carina	without median carina
long and fine	short and fine	
moderately long and slender	very long and slender	of less than average length
very distinct; long hairs	not very distinct; for the most part, only short hair	very well developed; long hairs
very slightly convex	distinctly concaved	slightly convex
margins fringed with long hairs	bearing only short spines and pubescence, with no long fringes	with hind fringes short or very moderate, never very long
long and rather slender; branches with broadly rounded apices	long, rather thick and powerful; branches very broad at base but narrowing rapidly to a sharply rounded, almost pointed, apex	short, thick and stubby; branches wide at base but narrowing rapidly to an almost pointed apex
very long and slender, gradually tapering from the base and with a broadly rounded and irregularly serrate-margined apical projection	broad and heavy; narrowest toward apex, with broadly rounded and recurved apical projections, with very coarsely and irregularly serrate margins	considerably wider at the base than toward the apex, apex appearing very hairy and obliquely truncate and with a rather narrow recurved apical projection
oblong or irregularly triangular, the inner lobe vestigial or absent	large and prominent, with outer lobe vestigial, irregularly quadrate, with inner posterior part pointed or nearly so	almost divided by a deep notch on the inner side, inner lobe triangular and pointed on inner side

(now referred to *dahlbomii* Guér.) and *thoracicus* (*emiliæ* D. T.) are South American and are placed by Franklin, following Radoszkowski, in the *Dumoucheli* group, together with numerous other species. Franklin has also placed a large number of American species in Radoszkowski's *Pratorum* group. *B. balteatus* Dlb., of the *Derhamellus* group, is probably a synonym of *B. kirbyellus* Curt. and was placed by Franklin in his *Kirbyellus* group together with other Old World species. The point, at present, is not what name should be given to the group but that the *Kirbyellus* group of America exists or has near relatives in the Old World. Franklin has renamed Radoszkowski's *Fervidus* group, calling it the *Borealis* group on the ground that the species which Radoszkowski identified as *fervidus* was really *borealis*, a not nearly related species. The *Terrestris* group of Radoszkowski is accepted by Franklin. It will thus be seen that all the groups of American *Bombus* are represented in the Old World.

Neither of the groups of *Bombias* have, as yet, had Old World species referred with certainty to them, although it seems probable that Franklin's *Fraternus* group is synonymous with Radoszkowski's *Wurfleini* group and Franklin suggests that *vorticosus* as described and figured by Schmiedeknecht, not the *vorticosus* of Radoszkowski's list, may belong to the *Auricomus* group.[1] As before, the main point here is that these groups, as well as the groups of *Bombus*, are represented in the Old World. According to the conclusions reached in this paper, I would expect the Old World species of *Bombias* to be most abundant in the western and southern parts of the range of the family.

Some of the more important distinguishing characteristics of the five American groups of *Bombus* are given in Table I. Franklin's key for separating the two groups of *Bombias* is as follows:

"Females with the disc of the clypeus finely and evenly punctate all over; the males with the third antennal segment as long as the fourth and fifth taken together . . . . *Auricomus*.

Females with at least the anterior part of the disc of the clypeus more or less smooth; the males with the third antennal segment at most not much longer than the fifth. . . . . *Fraternus*."

There is little doubt that the Bombidæ were derived from the *Euglossa-Hemisia* complex, probably from an ancient *Euglossa*, as has been indicated by Friese[2] and others. At the present time, these bees are confined to the

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[1] See pages 182 to 184 of the second part of Franklin's monograph. In Ent. News, 1915, XXVI, pp. 409–417, he refers additional Old World species to *Bombias*.

[2] Friese, H. 1900. Monographie der Bienengattung Centris (s. lat.). Annalen K. K. Naturhist. Hofmus., XV, p. 240.

Western Hemisphere and I know of no evidence which indicates that they ever were in the Eastern Hemisphere. Therefore, the Bombidæ probably originated in the New World, but this does not necessarily follow. At the present time the *Euglossa-Hemisia* complex is confined to the tropical and subtropical parts of America, but I do not consider this sufficient evidence to prove that the Bombidæ originated in the equatorial region. In fact I believe that quite the opposite is true.

As to the phylogenetic relationship of *Bombus* and *Bombias,* Franklin says, "Certain of the *Bombias* species, which the writer has placed in the *Fraternus* group grade up so closely to certain species of the *Dumoucheli* group of the subgenus *Bombus* that they could almost be included in that group. It is found, furthermore, that the species which Robertson placed in the genus *Bombias,* fall naturally into two apparently distinct and widely different groups, as shown particularly by the differences in the genitalia of the males. The differences between these two groups (viz., *Auricomus* and *Fraternus*) seem to strongly indicate that they have had separate origins. Their geographical distributions, as far as they have been worked out, seem to greatly strengthen this supposition.... The writer regards the *Fraternus* group of the subgenus *Bombias* and the *Dumoucheli* group of the subgenus *Bombus* as being very closely related and as being the most primitive of all the groups of the genus *Bombus* present in the New World." Fig. 1 shows the American distribution of the *Fraternus* and *Dumoucheli* groups, the closeness of the shading roughly indicating the relative dominance, as estimated by the number of species, in various parts of the ranges of the groups. It will be noted that these primitive groups have a southern distribution.

Although Franklin expressed the opinion that the *Auricomus* group of *Bombias* originated independently of the *Fraternus* group, he does not seem to have indicated its nearest relatives. The outer surfaces of the posterior tibiæ of the males are "somewhat concaved." This is true of the *Borealis* group but not of the others. It is probably a recent character as it seems to be a transference of a female secondary sexual character to the male. On the other hand, the inner lobe of the squamæ is "a mere tooth at the base of the outer one." In *Borealis* the outer lobe is vestigial while the inner lobe is vestigial in the *Pratorum* and *Kirbyellus* groups. There are only two species at present placed in the *Auricomus* group so that it is scarcely worth while to discuss its phylogeny further. They are probably relatively recent species and they have a moderately northern distribution.

The relationships of the other groups of American Bombidæ are also not as clear as one might wish and their relationships to the Old World groups are less so. Of course, the American groups may not have been derived one

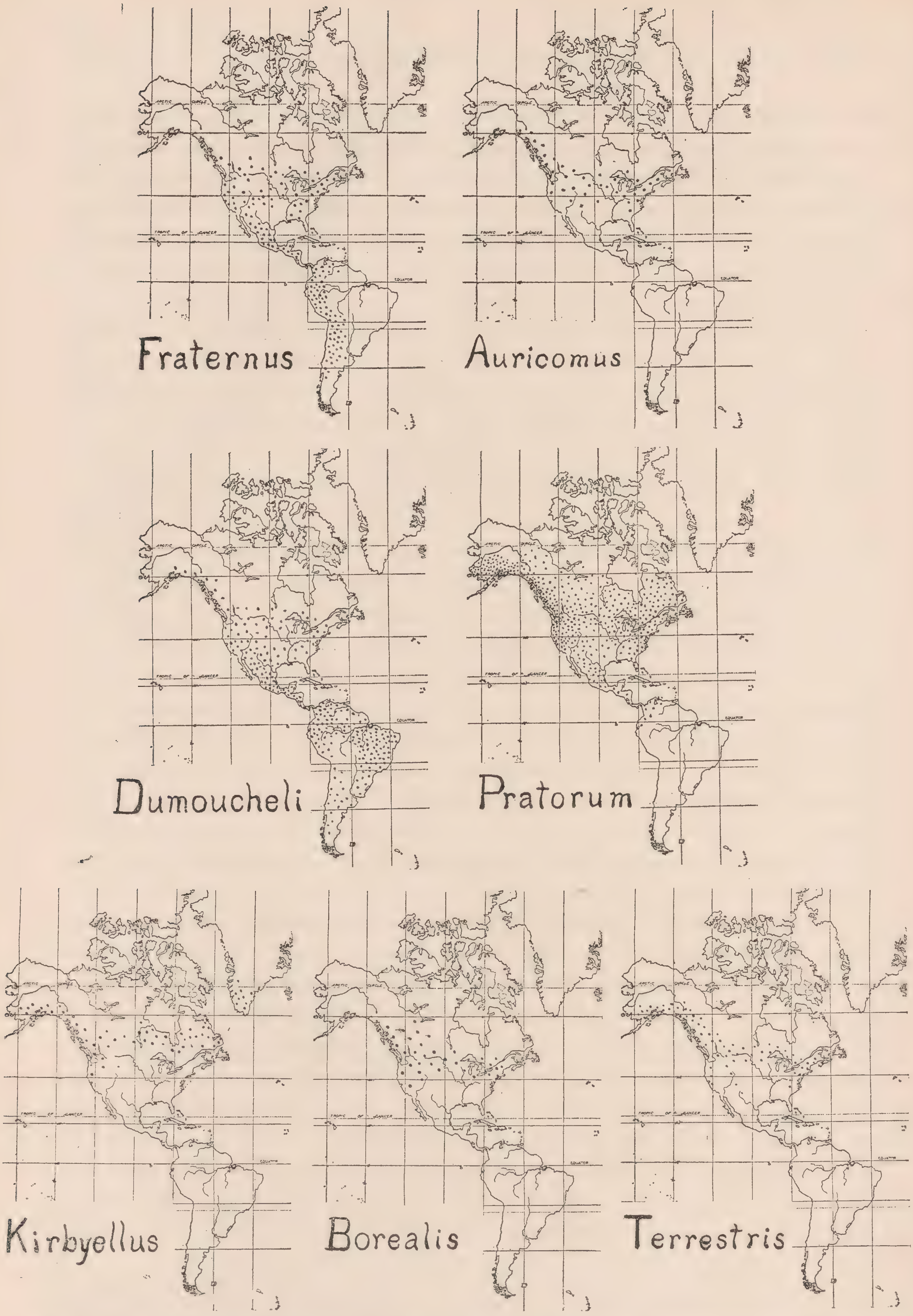

Fig. 1. The distribution, in America, of certain groups of *Bombus*. The relative number of dots in the various areas is roughly proportional to the number of species but the dots are not so placed as to indicate definite locality records.

from another but all, or a part of them, may have come from a group, or groups, which is now extinct or to be found only in the Old World. Furthermore, the groups may not be homogeneous, this being especially likely to be the case with *Pratorum.* However, some suggestions may be had from the table of characters given here. As a starting point we may follow Franklin in considering *Dumoucheli* to be the most primitive of the American groups.[1] On the other hand, "The sagittæ [of the male genitalia] attain their greatest complexity" in the *Terrestris* group (Franklin, p. 225) and the males of the *Terrestris* group have "very well developed corbiculæ" (p. 231). The latter character, like the concavity of the posterior tibiæ of *Auricomus* and *Borealis,* is a transference from the female to the male of a secondary sexual character and such a transference is usually considered to be a mark of relative lateness in phylogenetic history, so that we may start by putting *Dumoucheli* near one end of the series and *Terrestris* near the other.

The *Pratorum* group seems to be, in many ways, intermediate between *Dumoucheli* and *Terrestris* but certain characters, *e. g.,* the claspers, volsella and squama of the male genitalia, make it more probable that *Terrestris* is related more directly to *Dumoucheli* than through the intervention of *Pratorum.* However, the *Kirbyellus* group seems to have been derived directly from *Pratorum,* if from any of these, and *Borealis* may have been but it seems difficult to derive *Terrestris* from either *Borealis* or *Kirbyellus.* It will be noted that *Pratorum* is "variable" in many characters. This may be an indication of intermediateness or it may merely mean that the group, as now limited, is not homogeneous. Whatever the actual relationships, there are strong indications that the phylogenetic order is (1) *Dumoucheli,* (2) *Pratorum,* (3) *Borealis, Kirbyellus,* and *Terrestris.* From Fig. 1 it will be noted that this is also roughly the order, from south to north, of the centers of present-day distribution.

Table 2 gives a summary of the numbers of species in the various regions, taking the data given by Franklin in his monograph. The conclusions, drawn from this table and the discussion which has gone before, will doubtless differ. If these data were taken by themselves a very good case could be made out for the idea that the Bombidæ originated in South America from the *Euglossa-Hemisia* complex which is now and, as far as direct evidence goes, has always been confined to equatorial America. The *Sylvarum* group came first and spread to Asia and Europe but left no representatives behind. Then *Fraternus* and *Dumoucheli* originated either from

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[1] Franklin suggests that the Old World *Sylvarum* group is more primitive but as we do not know what species belong to it we cannot discuss its distribution. It is interesting to note that its type species is found in Ireland and southern England.

Sylvarum or directly from *Euglossa* and spread northwards, both reaching the far north and continuing through Siberia westward. As these groups spread northward they left representatives behind and gave rise to other groups, *Pratorum* first and later to *Borealis, Kirbyellus* and *Terrestris.*

Table 2. The number of species in various regions.

	Boreal N. A.	Nonboreal U. S.	Mexico and C. A.	S. A.	Total
Fraternus	1	6	10	12	23
Auricomus	1	1	—	—	2
Dumoucheli	1	3	11	15	24
Pratorum	14	9	5	2	27
Terrestris Borealis Kirbyellus	10	1 (or 2)	—	—	11

Although such a history might be possible, as far as the direct data go, I doubt that it is correct for several reasons: (1) such does not seem to have been the history of groups concerning which we have fossil evidence; (2) changes of climate in geologic time; (3) there are no *Bombus* in the Antilles, and they are rarer in the south temperate than in the north temperate, and (4) it seems to me much like rolling up hill for a group to leave the tropics and not only enter but become dominant in the Arctic. These reasons are stated in what seems to me to be the order of their importance.

1. We probably never will have sufficient fossil evidence concerning the ancient insect faunas to use it decisively in a discussion of distribution. However, if the evidence furnished by fossils of other groups show that all, or even most, of them originated in polar regions and moved toward the equator, we should see if the distributions of the other groups could be similarly explained. If they can, without a distortion of fact, such an explanation should be favored. Dispersal from polar, especially north polar, regions has so recently been discussed[1] that the arguments need not be repeated here.

2. It is well established that, in addition to minor fluctuations, there

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[1] Matthew, W. D. 1915. 'Climate and Evolution.' Annals N. Y. Acad. Sci., XXIV, pp. 171–318; Lutz, F. E. 1915. 'List of Greater Antillean Spiders with notes on their distribution.' Annals, N. Y. Acad. Sci., XXVI, pp. 71–148 and 1916. 'Faunal Dispersal.' Amer. Nat., L., pp. 374–384.

have been several large alternations between a zonal climate, cold at the poles, and a uniform warm climate. The creatures now under consideration are of so recent origin that doubtless only the last swing from mild at the poles to the present climate need concern us. If the Bombidæ originated, say with the *Sylvarum, Fraternus* and *Dumoucheli* groups, in the then mild north it is easy to believe that, as the climate there became more rigorous, the primitive species, being adapted to a mild climate spread southwestward (*Sylvarum*) and southward (*Fraternus* and *Dumouchlei*), and their place was taken by new forms adapted to the new conditions. These in turn gave place to still newer forms adapted to still more rigorous climatic conditions and to the environmental complex brought about by the new climate.

3. The only record of Bombidæ in the Antilles is *Bombus antiguus* Fab., which was described from Antigua but it is not known whether the island or one of the other numerous Antiguas was meant and, furthermore, there is even no certainty that it was a *Bombus*. It has never been found since but the name still hangs in the lists. In addition to all the other collecting which has been done, entomological expeditions from this museum have been in most of the Antilles, including Antigua, and none of them has brought back a *Bombus*. Now it is probable that if the Bombidæ originated in or near the American tropics some of the species would have found their way into the West Indies because, even though the family is a relatively recent one, that would mean that they had been in the adjacent continental region for a long time. Furthermore the islands offer environments which seem to be perfectly suited to Bombidæ and *Hemisia* is fairly abundant in them. Also, if Bombidæ originated in equatorial regions and spread out from there, one would expect to find them almost, if not quite, as abundant in the south temperate regions as in the north temperate ones. They do not seem to be; a fact which accords with the idea that they are of boreal origin and that only the van has reached South America.

4. The fourth reason need not be given much space. It is a feeling more than anything else and probably is largely anthropic. We know that men of northern countries are more vigorous than those of the tropics and have repeatedly spread into equatorial regions, displacing the natives. We "feel" that conditions in the arctic must be more rigorous than in regions of milder climate and it is difficult to believe that creatures adapted to a mild climate could successfully invade the boreal region and become dominant there.

The history, then, of Bombidæ in America seems to me to be that they originated in the north from the *Euglossa-Hemisia* complex at a time, presumably just prior to the last oncoming of zonal climate, when climatic conditions in the north were at least mild. Of the American groups, *Fraternus* and *Dumoucheli* were the first to appear and, as the climate became more rigorous, their immediate ancestors moved southward accompanied and followed by them. Certain species of these groups were, or became, adapted to the new conditions and lagged behind the others. Both groups sent representatives to the Old World and *Dumoucheli* probably gave rise to the *Pratorum* group. This in turn spread southward but it has only got half way, so to speak. The other groups came later but they contain so few species in America and they have spread so little, in the southern direction, although all of them have spread into the Old World, that the analysis is more difficult. The only reason for placing the area of origin in the northern New World rather than in the northern Old World is that the *Euglossa* complex, the presumed ancestors, seem to be confined to the New World.

Cockerell[1] has given us a short but interesting discussion of the phylogeny of *Bombus*, based upon his intimate knowledge of fossil insects. The following extracts show his views.

> The Bombidæ thus appear to have originated in Europe, but to have reached America as early as the Miocene.
>
> Although *Bombus* and *Psithyrus* are thus derived from *Calyptapis* in the diagram, this must not be taken too literally, as meaning that they are of American origin. *Calyptapis* very probably occurred in both hemispheres, as *Bombus* does to-day, or was represented in Europe and Asia by allied genera, from which *Bombus* might equally well be derived.
>
> It would even be possible to use *Calyptapis* as an argument in favour of the Old-World origin of *Bombus*. It is recognized that nearly all modern insect-genera are older than the Miocene; hence if *Bombus* already existed it would probably be in the Old World, and *Calyptapis* would represent an earlier type segregated in America, to be exterminated later by the invasion of *Bombus*.

As was indicated above, it is immaterial to the point of this paper whether *Bombus* originated in America or in the Old World or both. Cockerell's discussion of what may have happened to *Calyptapis* is right in line with the present argument — the ancestral type overcome (in this case exterminated) by a newer type moving from the north.

Further study of the more remote phylogeny may favor Siberia as the area of origin but the point which it is desired to make here is that new forms appeared in the north and that when newer forms appeared the older ones, for the most part, moved before them. It is not meant to imply that there was an absolutely linear progression but that, roughly, this was the order, individual species, however, lagging behind and catching up while, what is very important, new species originated and old ones died out along the way. The metaphor of a stream has been used. Perhaps that of a certain sort of rocket might be suggested: the progress of the rocket is in a certain definite direction but in its course it shoots stars in all directions and these, in turn, break up into other sprays of stars.

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[1] Cockerell, T. D. A. 1908. Descriptions and records of bees. XX. Ann. Mag. Nat. Hist., Ser. 8, II, pp. 323–334.

NOTES ON BOREAL SPECIES.

Fraternus group.

In giving the distinctive characters of *Bombias,* Franklin says "The apices of the hind metatarsi usually not drawn out into so prominent and acute a projection, behind the insertion of the second tarsal segment, as is the case in the subgenus *Bombus*" and notes that *Bombias rufocinctus* and *mexicensis* are two of the more notable exceptions to this. *B. rufocinctus* is the most northern species of the Fraternus group, in fact, the only boreal or subboreal representative, while *mexicensis* is little more than a southern form of it. I fear we cannot say, at present, whether *Dumoucheli* came from *Fraternus* or the reverse but, if we should look to the north for recent forms, this northern *Bombus*-like *Bombias* would indicate that *Dumoucheli* came from *Fraternus.* In that case we would need to explain why *Fraternus,* in South America, has largely kept to the mountains while *Dumoucheli* has spread out over the lowlands. It might be because the lowlands were too swampy when *Fraternus* reached there (there being evidence that such might have been the case up to late Tertiary) and dry enough for Bombids when *Dumoucheli* arrived, but I think such an explanation is rather lame and the character noted is so slight that it needs support before much reliance can be placed upon it in tracing relationships. Considering the more fundamental differences between *Bombus* and *Bombias,* such as in the position of the ocelli and venation of the wings, it seems likely that the form of the metatarsus of *B. rufocinctus* is a reversion to the *Bombus* pattern or even that the two groups originated from the *Euglossa* complex independently. If *Fraternus* is a more recent group than *Dumoucheli* we can readily understand why it has not, as yet, established itself generally on the lowlands of South America.

B. rufocinctus is at home in the mountains of western United States and the following points outline its known range: British Columbia, Quebec, New York, Kansas, New Mexico.

Dumoucheli group.

In the far north this group is represented only by *californicus* Smith (*neglectulus* Ashmead). Like *Bombias rufocinctus,* this species is extremely variable. There may be nothing in it but one is tempted to wonder whether there is any relation between extreme variability — plasticity — of a species and recentness of origin. More likely the connection in these cases is between variability and distribution in regions of extreme isolation. The range of *californicus* is from southern Alaska to Saskatchewan and south to Lower California and New Mexico. There is no representative of the *Dumoucheli* group in the eastern boreal region, *fervidus,* a species closely related to *californicus* belonging rather to the Transition. *B. pennsylvanicus* is also close to these, especially to *fervidus.* It belongs to the austral fauna of the United States.

Franklin considers "*montezumæ* and *nigrodorsalis* the most primitive of all the New World species of *Bombus.*" The former is now considered to be a variety of the latter. The species occurs from Mexico to Costa Rica, while *wilmattæ* Ckll., with its closest ally in *nigrodorsalis,* is recorded from Guatemala and Ecuador. Franklin does not give his reasons for believing these to be the most primitive but, even if they are so, the theory of dispersal from the north is not negated by the finding of the most primitive forms stranded along the way.

Pratorum group.

The published records of *B. ternarius* Say place it rather definitely in the boreal fauna, the most northern being central Alberta on the west and Prince Edward Island on the east, while the most southern records are South Dakota and West Virginia. In the southern part of its range, its distribution is "spotty." The following localities, extending its known range, may be added from our collection: Battle Harbor, Labrador (C. W. Leng); and Lake Marcia, Sussex Co., New Jersey (F. E. Lutz).

B. edwardsii Cresson shares with *rufocinctus* (and *californicus*) the honor of having "probably caused the workers on the Bombidæ of North America more trouble than most others" because of its variability. It also is of our western mountains, ranging from southern Alaska to Alberta and south to Beulah, New Mexico. Franklin suggests that "sufficient collecting is likely to show that those color variants with the second and third dorsal abdominal segments largely covered with ferruginous-red pile are much more numerous in the southern part of its range (Colorado, Utah, Nevada, California and New Mexico) while those color variants which have these segments mostly black are much more numerous in the northern part (Alaska, British Columbia, Alberta, Montana, etc.) — this is evidently the case in Montana and Colorado and only the *nearcticus* form has been taken in Alaska. As will be seen, this apparent characteristic is closely paralleled in the case of *flavifrons* and *rufocinctus*." We have specimens from Vancouver which have the pile on the second and third segments reddish, but in many other ways the fauna of Vancouver Island is more southern than its geographic position. This may be because it is an island, a refuge for the older, more southern, forms. Our specimens from Banff, Alberta, have these segments black or black and yellow.

Bombus melanopygus Nylander belongs to the western boreal fauna, ranging from southern Alaska to Baffin Land south to Colorado but not east of Saskatchewan and Colorado in the southern part of its territory. We have a male from above 6000 feet altitude near Colorado Springs, Colorado (H. F. Wickham).

Bombus sylvicola Kirby is purely boreal — Point Barrow, the northern extremity of Alaska, to Ungava Bay and Labrador. It does not appear to have reached southern Canada. We have it from Langton Bay, Northwest Territory (R. M. Anderson).

Bombus gelidus Cresson. After giving Aleutian Islands, Popoff Island, Koyukuk River, Kukak Bay and Nualaska as the distribution of this species, Franklin adds "one worker before me, which seems to be a little aberrant in coloration, from Signuia, Baffin Land (Schuchert and White), appears to belong to this species." We have five specimens collected by Mr. C. W. Leng at Battle Harbor, Labrador, which certainly seem to be *gelidus* so that the species is to be looked for throughout northern Canada.

Bombus perplexus Cresson is recorded from the Hudson Bay Country, Manitoba to Quebec and in the mountains to Tennessee and North Carolina; also from North Dakota to Michigan. Mr. Wm. T. Davis has a specimen from the mountains of Georgia which seems to be this species.

Bombus bolsteri Franklin was described from four queens and five workers from Newfoundland. We have numerous workers from Spruce Brook (C. W. Leng) and Codroy (L. P. Gratacap), Newfoundland, as well as three specimens from Spruce Brook which appear to be the undescribed male of this species. They have

Face, including the clypeus, densely covered with pile to above the bases of the antennæ, yellow but with a strong sprinkling of black especially around the antennæ; pile of the occiput yellow (a few black hairs on one specimen), above the eyes black. Malar space somewhat longer than its width at the apex. Fifth antennal segment very slightly longer than the third, the third somewhat longer than the fourth. Pile of the thorax and scutellum yellow except for a very broad black interalar band which starts, in one of the specimens, with scattered black hairs among the yellow of the anterior dorsal part and, in two of the specimens, has a projection on the median portion of the scutellum. The pile of the dorsum of the abdomen is yellow on the first and second segments and black on the third and fourth; in two of the specimens the pile on the fifth and sixth segments is largely yellow but in the other specimens this pile is largely black except for the posterior angles of the fifth segment; seventh segment dark. Hind tibiæ with the outer surface largely bare; the median area broadest near the apex, smooth and shining; long lateral hairs black. Short hairs on the hind metatarsi reddish, the long hairs on the basal portion of the posterior border black. Genitalia much like those of *vagans*.

It will be noted that one of Franklin's distinctions between this species and *vagans*, the yellow fifth dorsal abdominal segment, does not apply strongly to one of the males. One of our females also has no yellow back of the second segment, and in another the yellow on the fifth segment is strongly mixed with black.

Bombus couperi Cresson belongs to the eastern boreal fauna, being known from Labrador, the region of Newfoundland, Ontario and Isle Royale, Lake Superior.

Bombus frigidus F. Smith reaches from Alaska to Labrador and Newfoundland. In more southern regions it seems to be confined to the west where its distribution is spotty and high in the mountains, *e. g.* "Truchas Peak, above timber line" and "top of Las Vegas Range," both from New Mexico by T. D. A. Cockerell. We have a male from the Athabasca River, Alberta (R. M. Anderson) and a worker from Collins, Idaho.

Bombus pleuralis Nylander, appears to be confined, in America, to the Alaskan region but it has been reported also from Siberia.

Bombus flavifrons Cresson ranges from Alaska to Alberta and, in the mountains, south to Beulah, New Mexico. More eastern records have been given but Franklin doubts them. We have a specimen from Truches Peak, New Mexico (W. P. Cockerell). Franklin notes that this species may not be distinct from *pleuralis*.

Bombus sitkensis Nylander appears to be common in Alaska and British Columbia. It occurs at least as far south as California and Idaho but apparently has not extended its range eastward.

Bombus mixtus Cresson occurs from Alaska to Labrador and south, in the mountains, to California and Colorado. It is most abundant in the northwestern part of its range.

Bombus alboanalis Franklin includes a number of records for *hortorum* in America and some of those for *sitkensis*. In America it seems to be confined to Alaska but it is reported from northeastern Asia and may not be distinct from the European *hortorum* (Linné).

This list included fourteen species, or alleged species, of the *Pratorum* group which may be considered boreal although *ternarius* and *perplexus* are doubtfully so; neither have been recorded from Alaska, Labrador or Newfoundland. Of the remaining twelve, ten are recorded from Alaska and six from either Labrador or Newfoundland or both. Six of these Alaskan species have not been found on the east coast and only two of the eastern species are not found in the west. Furthermore the species which do not extend from coast to coast seem to be more common in the western part of their range. Finally there are only twenty-seven described American species in the group, as listed by Franklin, so that about half of the group is included here. The impression one gets is that the center of the group, as far as America is concerned, is in northwestern Canada with a gradually diminishing representation east and, especially in the mountains, south. It would be interesting to trace relationships of the species in order to determine whether the more recent ones are in the Northwest or near the edges of the range but that seems almost impossible at present. However, if the reader will kindly remember that the following suggestions are purely tentative and made largely in the dark no great harm will be done. The statements of relationships are based largely on scattered remarks by Franklin. See Fig. 2.

B. pulcher and *ephippiatus* are closely related to each other but as we are following Franklin and as he does not state their relationships to the other members of the group they will not be considered further except to say that they are the only *Pratorum* species reported from South America. *B. impatiens* is the only species of the group recorded from Florida and from it all the other species may be derived. Let us suppose that *B. impatiens* was the first member to originate in the northwest. From it came *bimaculatus* and *vagans,* each starting a line. To anticipate, these moved south and east with *impatiens* in the van and finally reaching Florida. Now let us follow the *vagans* line because it is simpler; however it probably developed later than the *bimaculatus* line. It gave off *perplexus, cockerelli* and *bolsteri;* the first is now found throughout much of the range of its parent, the second in mountains of New Mexico, where its parent does not seem to be and the last in the extreme northeast, Newfoundland. From *bolsteri* came *couperi,* now found just back of it, *i. e.* Labrador to Newfoundland and Lake Superior; then *frigidus,* Labrador, Newfoundland, Hudson Bay, Mackensie and Alaska. *B. frigidus* is also closely related to the Old World *rajellus,* and from near *frigidus* we got a set of species which went southward rather than eastward: *mixtus,* first, which reached Labrador on the east but California and Colorado on the south; *sitkensis* and *alboanalis* from it, the former now ranging from Alaska to California and Idaho, the latter

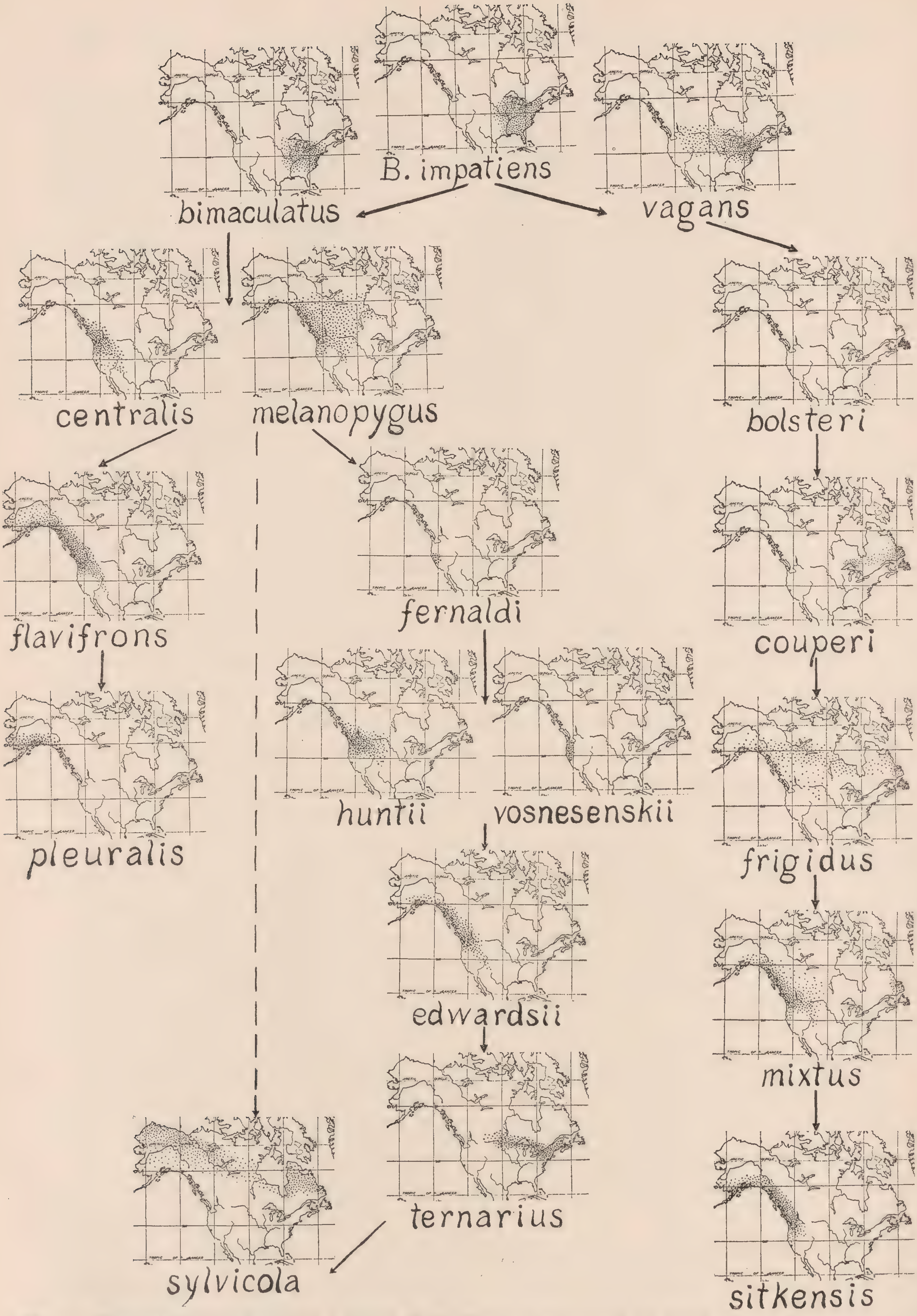

Fig. 2. The suggested phylogeny of a portion of the *Pratorum* group and the distribution of the species. The shading indicates general areas but the individual dots do not refer to definite locality records.

only in Alaska but related to the Old World *montanus*. Finally, the Pacific Coast *ambiguus* is probably only a form of *sitkensis*.

The *bimaculatus* strain is not so "simple," partly because of the uncertain relationships of the Rocky Mountain forms. *B. melanopygus* seems to have come from *bimaculatus* and to have been the starting point for a number of species. Franklin says it is "apparently a common species throughout western Canada and in southern Alaska, but for the most part rare in Canada east of the Rocky Mountains and, in the western United States, rare (very rare in Wyoming and Colorado) and confined mostly to the mountain chains, being a strictly Boreal form." It is closely related to the European *lapponicus* on the one hand and on the other hand *centralis* seems to be its southern offshoot. Perhaps *centralis* and *melanopygus* originated separately and in that case distribution would indicate that *centralis* is the earlier species, being now found from British Columbia to Nebraska, New Mexico and California. From the *centralis-melanopygus* combination, and perhaps directly from *centralis*, came *flavifrons*, Alaska to Alberta and New Mexico; and from it *pleuralis*, Alaska and (?) Siberia. From *melanopygus*, *sylvicola*, Alaska to Labrador, and *gelidus*, Alaska to Baffin Land may have been derived, but see below. Finally, there is a group which seems to have been derived from *melanopygus* through something close to the recently described *fernaldi*, California and Nevada. There is *vosnesenskii*, Washington to Nevada and southern California and *huntii*, Washington to Colorado, New Mexico and California, except the Lower Austral portions. *B. trinominatus* extends the distribution of *vosnesenskii* to Mexico and *laticinctus* does the same for *huntii*. From the *huntii-vosnesenskii* combination, but from nearer *huntii*, we got *edwardsi*, Alaska, to New Mexico and California. It seems to have given off *ternarius* which moved eastward and southward, Alberta to Prince Edward Island, South Dakota and West Virginia, in front of its offshoot, *sylvicola*, Alaska and Saskatchewan to Labrador, if we derive *sylvicola* from *ternarius* rather than directly from *melanopygus*.

In any discussion such as has just been indulged in there is danger of unconsciously twisting the data to fit the theory. A reference to Franklin's paper will, I think, show that such twists have been largely avoided in the present instance. The case of *centralis* would have fitted in more smoothly if that species had been indicated as closely related to *bimaculatus* but the irregularity is not serious and furthermore it may really have been derived from *bimaculatus* and yet now appear to be more closely related to *melanopygus*, another derivative, than to its parent species. My only fear is that I have proved too much. I do not expect that every group of animals would work out with such regularity and the danger is that the student, finding that they did not, will discard the whole idea. Among the many sources of confusion, polyphyletic origins, backward movements of faunas and incorrect interpretations of phylogeny may be mentioned as the most likely to occur. I have not attempted a similar analysis of the other groups of *Bombus* since, with the exception of the *Dumoucheli* group there are too few species to make it interesting and Franklin does not give enough data to make the task of connecting up the various parts of the *Dumoucheli* group easy.

Kirbyellus group.

All of the *Kirbyellus* groups in America are boreal.

Bombus kirbyellus Curtis ranges from Siberia to Labrador and Greenland, southward through British Columbia and Alberta to Colorado and Truchas Peak, New Mexico, but not, as yet reported, from California. Through the courtesy of Mr. B. Preston Clark we have a number of specimens from Kadiak, Alaska, which Mr. Franklin says are probably aberrant males of this species.

Bombus kincaidii Cockerell is known only from the Pribilof Islands.

Bombus strenuus Cresson; Fort Yukon and Fort Cosmos, Alaska; Hudson Bay Country.

Bombus polaris Curtis is recorded from Labrador and Greenland but Franklin discredits Ashmead's report of this species in Alaska. We have a number of workers collected by V. Stefansson at Barrow, Alaska, and a queen collected by R. M. Anderson at Tupkak in the delta of the Mackenzie which certainly seem to be *polaris* although they have been in alcohol and identification is difficult.

Bombus arcticus Kirby: "Greenland and Arctic Canada. It seems not improbable that this is the same species which is present in the northern regions of Europe and Asia and is known as *B. hyperboreus* Schönherr."

It should be noted that the only species of *Bombus* recorded from Greenland belong to the *Kirbyellus* group, that three of the five American species of this group occur in Greenland and that two of these three are probably specifically identical with Siberian species.

Borealis group.

There are only two American species of the *Borealis* group given in Franklin's monograph.

Bombus borealis Kirby is not so boreal as many other species of Bombus. Its recorded northwestern limit is Alberta (Beaver Lake) and its northeastern, Newfoundland; its recorded southern limits are North Dakota and Massachusetts. We have specimens from Boisedale, Cape Breton Island (C. W. Leng); Codroy, Newfoundland (L. P. Gratacap) and Campo Bello Island, southern New Brunswick.

Bombus appositus Cresson. The only Canadian records are from British Columbia (Kelowna, the most northern) and it reaches its greatest abundance in northwestern United States, extending however to Colorado and New Mexico. It should probably, but not certainly, be classed as boreal.

Terrestris group.

The final American group is *Terrestris*. One of the species, *occidentalis*, joins *edwardsii*, *californicus* and *rufocinctus* in being extremely variable and as they all have much the same range the difficulty of identification is greatly increased and the supposition strengthened that there is something in the environment which is responsible for the variability.

B. occidentalis Greene is found throughout a great part of Alaska, British Columbia and western Alberta; extending south to California and New Mexico. The geographic extremes in our collection are Banff, Alberta (*ex* J. L. Zabriskie collection) and Beulah, New Mexico (T. D. A. and W. P. Cockerell). Franklin states that *occidentalis* is related to *terrestris* on the one side and *terricola* on the other.

Bombus terrestris (Linné) is mainly a palearctic species but what is probably a variety of it, *moderatus* Cresson occurs in Alaska and probably Yukon. We have a fine series of this species from Kadiak, Alaska, given us by Mr. B. Preston Clark. There is a tendency in both males and females (including workers) for the yellow on the thorax and second segment of the abdomen to be white; in fact, it is quite white in some specimens.

Bombus terricola Kirby belongs to the lower and eastern Boreal: Alberta to Newfoundland and south to North Dakota and Rhode Island according to the records, but we have a male from Ramsey, N. J. (F. E. Lutz) and a worker from the Black Mountains, North Carolina (Wm. Buetenmuller). Our most northern specimens are from Boisedale, Cape Breton Island and Codroy and Spruce Brook, Newfoundland.

The only other American species of the *Terrestris* group is *affinis* Cresson and it can scarcely be considered as boreal.

59.9 (81)

Article XXVII.— NEW MAMMALS COLLECTED ON THE ROOSEVELT BRAZILIAN EXPEDITION.

By J. A. Allen.

Six of the ten species of mammals here recorded as apparently new were collected on the Roosevelt Brazilian Expedition in 1913–1914, in the State of Matto Grosso, Brazil. Of the others two (*Œcomys emiliæ* and *Proechimys boimensis*) are from eastern Brazil, one (*Œcomys florenciæ*) is from the Caquetá district of Colombia and the other (*Molossus daulensis*) from Ecuador.

Proechimys boimensis sp. nov.

Type, No. 37486, ♂ ad., Boim, Rio Tapajos, Brazil, Oct 10, 1911 (ex Museu Goeldi).

Upperparts bright yellowish rufous, sparsely varied mesially with black-tipped hairs, the pelage soft except for a few intermixed stiffish hairs on the middle of the back; underparts clear white, sharply defined against the orange rufous of the sides; inside of upper arms and inside of thighs naked; ears long and narrow, naked, light brown; fore feet buffy gray, edged with white on the inner margin; hind feet above pale yellowish white, soles pale brown; tail very light brown above, much lighter below, and tuftless, the annulations not obscured by the scanty short bristly hairs.

Total length, 348 mm.; head and body, 199; tail, 149; hind foot, 45; ear, 25.

Skull long, narrow and lightly built. Total length, 56.3; zygomatic breadth, 23.2; interorbital breadth, 10.5; breadth of braincase, 19.6; nasals, 22 × 6; maxillary toothrow, 7.1; diastema, 11; palatal foramina, 5 × 3.

Represented only by the type, an old male with the teeth much worn. Received from the Museu Goeldi as *Proechimys oris*, with three specimens of true *P. oris* from Cametá, Rio Tocantins, and two specimens of true *P. goeldii* from Faro, on the Amazon, not far from the type locality of *goeldii*.

Prœchimys boimensis differs so strongly from any other species of the genus that it scarcely needs comparison with any of them. Its small size, weak structure, the strong orange rufous coloration of the upperparts (slightly darkened with blackish mesially and bright orange rufous on the sides), and its soft pelage serve at once to distinguish it.

Œcomys milleri sp. nov.

Type, No. 37117, ♂ ad., Barão Melgaço, Matto Grosso, Brazil, March 5, 1914; Leo E. Miller, for whom the species is named (Roosevelt Expedition).

Similar in general coloration and size to *Œ. bicolor* (Tomes). Pelage soft, short and thick. Upperparts uniform dark cinnamon brown, finely lined with black; underparts clear white (slightly tinged with fulvous in some specimens), the hair short and velvety, and white to the base; no fulvous lateral line as in *bicolor*, the white of the underparts being sharply defined against the cinnamon brown of the flanks; ears prominent, dark brown, nearly naked externally; feet flesh-colored, slightly clothed with very short pale cinnamon-colored hairs; tail blackish brown, very finely annulated, the short fine dusky hairs not concealing the scales except towards the tip, which is more thickly haired and slightly tufted.

Total length of type, 185 mm.; head and body, 95; tail vertebræ, 90; hind foot, 20. The type and 5 topotypes: Total length, 198 (185–210); head and body, 98.6 (95–100); tail vertebræ, 98.3 (80–110); hind foot, 22.

Skull of type, occipitonasal length, 24; zygomatic breadth, 13; interorbital breadth, 5; breadth of braincase, 11.2; palatal foramina, 5 × 2.5; maxillary toothrow, 3.5; diastema, 6.

Represented by the type and 5 topotypes, and by a single specimen from Urufá, on the upper Gy-Paraná.

This species belongs to the *Œcomys bicolor* (Tomes) group, but differs from it in the ventral surface being clear white instead of yellowish white, and in other minor color differences and in slightly smaller size. It differs similarly from *Œ. florenciæ*, described below from the Caquetá drainage of southwestern Colombia.

Œcomys florenciæ sp. nov.

Œcomys bicolor Allen (not *Hesperomys bicolor* of Tomes), Bull. Amer. Mus. Nat. Hist., XXXV, p. 210, May 31, 1916.

Type, No. 33863, ♀ ad. (skin only), Florencia (altitude 675 feet), Rio Caquetá drainage, southwestern Colombia, June 25, 1912; Leo E. Miller.

Closely similar to *Œ. bicolor* (Tomes), from the western slope of the Andes, near Pallatanga, Ecuador, even to the fulvous tinge of the white underparts.

Upperparts cinnamon brown, darkened along the middle of the back by black-tipped hairs; sides paler and more yellowish, forming at the lower edge a quite distinct golden-fulvous lateral line, extending anteriorly to the sides of the nose; head, from the eyes anteriorly, paler and grayer than the back; whole ventral surface strongly suffused with pale buff, varying much in intensity in different specimens; upper surface of feet pale buffy gray, the soles blackish brown; ears dark brown, sparsely haired; tail dark brown, unicolor, the annulations distinctly visible through the fine short brownish hairs, which increase in amount apically and form a slight terminal tuft.

Type, total length, 200 mm.; head and body, 100; tail vertebræ, 100; hind foot, 22. A series of 4 topotypes: Total length, 197 (190–200); head and body, 97 (90–100); tail vertebræ, 100 (all 100); hind foot, 22 (all 22). The skulls of the entire series were unfortunately lost.

Represented by 6 specimens, all from the type locality.

This form is slightly larger than either *Œ. bicolor* or *Œ. milleri* and differs from the latter especially in the color of the ventral surface. I formerly referred these Florencia specimens to *Œ. bicolor*, but it is a slightly larger form, and somewhat different in color. The three forms are probably merely geographic races of the same specific group, for which *bicolor* is the earliest name. The known range of the group is now extended eastward to western Matto Grosso.

Œcomys emiliæ[1] sp. nov.

Type, No. 37495, ♂ ad., Rio Mojú, Pará, Brazil (ex Museu Goeldi), Feb. 28, 1914.

Upperparts, in general effect, pale buffy grayish brown, with a slight mixture of black-tipped hairs, passing into pale yellowish gray on the sides; no yellow lateral line; underparts sharply defined clear white, the fur very short, soft, velvety, and white to the base; ears pale brown, apical two-thirds nearly naked, basal third heavily clothed with long fur tipped with dusky brown; tail heavily clothed for the basal half-inch and concolorous with the back; rest of the tail uniform dusky brown, the hairs nearly concealing the annulations, increasing in abundance toward the tip, which is strongly tufted; upper surface of fore and hind feet dull brown with a slight buffy tinge, the edges and the toes white faintly tinged with pale buff; soles flesh-color; a rather distinct narrow blackish eyering; whiskers abundant, very long and black.

Total length, 300 mm.; head and body, 135; tail, 165; hind foot, 28; ear, 16.

Represented by only the type, the skull of which has unfortunately been mislaid.

This species appears to be very distinct from any described form of either *Œcomys* or *Rhipidomys* from eastern Brazil. In coloration it bears some resemblance to *Rhipidomys cearanus* Thomas, but it is very much larger and otherwise obviously different.

Oryzomys (Oligoryzomys) microtis sp. nov.

Type, No. 37091, ♂ ad., Lower Rio Solimoens (fifty miles above mouth), April 29, 1914; Leo E. Miller (Roosevelt Expedition).

Similar in size and general coloration to *O.* (*Oligoryzomys*) *navus* Bangs, but very much less rufous above and clearer white below, and with very much smaller ears. Upperparts dull yellowish brown, finely lined with black-tipped hairs; underparts white (in type, faintly tinged with buff in some specimens); upper surface of feet thinly clothed with light buffy brown hairs; soles dark brown; tail shorter than head and body, brown, nearly naked, finely annulated, the tip not distinctly tufted; ears small, brownish, nearly naked.

Total length (type), 183 mm.; head and body, 93; tail, 90; hind foot, 20. Six topotypes: Total length, 178; head and body, 93; tail, 88; hind foot, 21.2.

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[1] Named in honor of Dr. Emilie Snethlage, Director of the Museu Goeldi, Pará, Brazil, through whose kindness the American Museum of Natural History has received valuable collections of both birds and mammals secured by her during her important explorations in eastern Brazil.

Skull (type), total length, 23; zygomatic breadth, 11.5 (?), interorbital breadth, 3.7; breadth of braincase, 15; palatal foramina 4 × 1.3; maxillary toothrow, 3; diastema, 5.

Represented by 8 specimens, all from the type locality.

Readily distinguished by pale coloration, relatively small ears, and tail less than half the total length.

In this connection I have had occasion to take up the *Oligoryzomys* group somewhat in detail, with the following results. It is a natural group, as has been repeatedly admitted by different authors, but is perhaps better recognized, for the present, as of only subgeneric value. It contains a considerable number of species and subspecies, and has a wide distribution, ranging from southern Mexico to the coast region of Peru in the west and from Trinidad and the northern coast region of Venezuela to the southern provinces of Brazil. The members of the group are readily recognized by the external characters of small size and very long tail (usually decidedly longer than head and body), which in most forms is distinctly tufted at the end. The material at present available is insufficient for a satisfactory review of the group, but the following seem referable to it, and still others, among them some of the earlier described species, appear also to belong to it, including the *Oryzomys stolzmanni* group.

The group includes two types of pelage, one of which, including most of the species, has the pelage short and fine, but in the *humilior* group it is soft and woolly.

The Mexican and Central American forms that have been recognized[1] are probably only geographic races of *O. fuscescens* (Saussure). A reëxamination of *vegetus,* of Chiriqui, proves it to be quite easily distinguishable from either *fulvescens* or *costaricensis.* *O. nicaraguæ* is known only from the adult type and a half grown specimen; the type is distinctly different from either of the other forms, and the half-grown specimen differs strongly from two specimens of *costaricensis* of corresponding age, the only available specimens of either of the other forms that are comparable with it.

The first form described from northern South America is *O. delicatus* Allen and Chapman (1897), from a single mutilated specimen from the Island of Trinidad; it appears to be quite distinct from any of the later described forms from continental South America.

O. humilior Thomas[2] (1898) is the first described member of a widely distributed South American group, to which is referable *O. fulvirostris* Allen (1912), representing in the Western and Central Andes *O. humilior* of the Eastern Andes, the Santa Marta region and the Merida Andes.

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[1] *O. fulvescens* (Saussure), 1860. State of Vera Cruz, Mexico.
O. costaricensis Allen, 1893. Costa Rica.
O. (*O.*) *vegetus* Bangs, 1902. Chiriqui.
O. (*O.*) *nicaraguæ* Allen, 1910. Vijagua, Nicaragua.

[2] *Oryzomys dryas humilior* Thomas, Ann. and Mag. Nat. Hist. (7), II, p. 268, Sept. 1898. Plains of Bogota. Not closely related to *dryas,* referred by Thomas in 1906 to *Œcomys,* "as probably = to *Œ. bicolor* (Tomes)."

O. (*O.*) *navus* Bangs (January, 1899), the type of *Oligoryzomys,* is also a member of a wide ranging group, which includes *O. tenuipes* Allen (December, 1899) described from the Merida Andes,[1] and *O.* (*O.*) *munchiquensis* Allen (1912) from the Eastern Andes. *O. tenuipes* ranges to the northern coast of Venezuela, and differs from *navus* in having the ventral surface buffy instead of clear white, while *munchiquensis* has the ventral surface grayish white and the upperparts darker than in either *tenuipes* or *navus.* *O. griseola* Osgood (1912), from the Paramo de Tama (Colombia-Venezuela boundary) is doubtless covered by the series I refer to *tenuipes;* but *griseola* is unknown to me and may be a recognizable subspecies of the *tenuis* 'complex.'

O. arenalis Thomas (1913), from the desert coast region of Peru is unknown to me but is referred to by the author as "a very small pale form of the '*Oligoryzomys*' group."

It seems necessary to add to the foregoing the following two forms from southwestern Matto Grosso.

Oryzomys (**Oligoryzomys**) **utiaritensis** sp. nov.

Type, No. 37541, ♀ ad., Utiarity, Rio Papagaia, Matto Grosso, Brazil, Jan. 30, 1914; Leo E. Miller (Roosevelt Expedition).

Closely resembles *O. stolzmanni* but paler and more yellowish above and somewhat smaller.

Upperparts clay-color finely line with black-tipped hairs over the back, nearly pure clay-color on the sides; front of head and nose darker and slightly grayish; underparts grayish white, the hairs darker at base; upper surface of feet paler, about flesh-color, soles dark brown; ears large, light brown, nearly naked; tail longer than head and body, finely annulated, light brown and nearly naked, the apical portion with short, bristly grayish hairs.

Total length, 220 mm.; head and body, 100; tail vertebræ, 120; hind foot, 22; ear from crown (in skin), 14. Skull, total length, 24; condylobasal length, 23; zygomatic breadth, 12 (?); breadth of braincase, 11; length of nasals, 9; maxillary toothrow, 3.5; palatal foramina, 4 × 1.5; diastema, 5.

Represented by two specimens, both from the type locality. The second specimen is a young adult, much younger than the type.

This species resembles *O. stolzmanni* in size and general appearance, but is smaller, the coloration above is much yellower, the pelage less woolly, and the tail relatively shorter. It is less closely related to *O. eliurus*, with authentic specimens of which it has also been compared.

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[1] The two specimens recorded (*antea*, p. 214) by me from Bogotá as "near *tenuipes*" prove to be referable to *navus*, of which I then had no specimens for comparison.

Oryzomys (Oligoryzomys) mattogrossæ sp. nov.

Type, No. 37542, ♂ ad., Utiarity, Matto Grosso, Brazil, Jan. 31, 1914; Leo E. Miller (Roosevelt Expedition).

Similar in general to *O. utiaritensis* but the upperparts with a more rufous tone, especially on the rump; the underparts are light ochraceous buff instead of grayish white, and the tail is relatively much longer. Total length (type), 210 mm.; head and body, 95; tail, 115. Paratype (No. 37100, Guatsué), total length (from a well-filled skin), 220; head and body, 90; tail, 130; hind foot, 20; ear, 15. Skull, total length, 24; condylobasal length, 22.3; zygomatic breadth, 12.2; breadth of braincase, 11; length of nasals, 9; maxillary toothrow, 3; palatal foramina, 4 × 1.3; diastema, 5.

This species is obviously different from the above-described *O. utiaritensis*. The underparts are strongly buffy instead of white, the upperparts have a rufous tone, and the tail is relatively longer — very much longer in the paratype. The type is from the same locality as the type of *O. utiaritensis*, and the paratype was collected at Guatsué, a nearby point, showing that both forms occur together. In so small a series (2 specimens of each form) it is possible that the differences are due to individual variation, but this does not seem at all probable.

Zygodontomys tapirapoanus sp. nov.

Type, No. 37518, ♀ ad., Tapirapoan, Rio Sepotuba, Matto Grosso, Brazil, Jan. 19, 1914; Leo E. Miller (Roosevelt Expedition).

Upperparts yellowish brown minutely punctated with black; sides paler, without black punctation; underparts dull gray with a yellowish wash, usually faint but sometimes strongly developed, the basal portion of the hairs plumbeus, only the tips light; ears dark brown, nearly naked; upper surface of fore and hind feet dark brown, the extreme tips of the hairs grayish; tail dark brown above, slightly lighter below, thinly clothed with short fine bristly hairs, not concealing the annulations above but often quite concealing them below. In occasional specimens the scaling of the tail is wholly concealed by hairs, both above and below.

Type, total length, 210 mm.; head and body, 130; tail vertebræ, 80; hind foot, 25. Six young adult topotypes (the type and all of the series of 9 topotypes are young, with the teeth wholly unworn): Total length, 193 (190–200); head and body, 117 (110–120); tail 80 (70–90); hind foot, 24.3 (22–25). Six old adults from Utiarity and Tres Burity, with the teeth worn down so that no trace of the cusps remain: Total length, 212 (200–220); head and body, 117 (110–130); tail, 84 (80–90); hind foot, 25 (23–26).

Skull, type, and an old skull with greatly worn teeth, respectively, total length, 29.5, 30; zygomatic breadth, 15.8, 16; breadth of braincase, 12, 12.3; interorbital breadth, 5, 5; nasals, 9.5 × 3, 11 × 2; maxillary toothrow, 5, 4.3; palatal foramina, 7 × 2, 7 × 2; diastema, 7.5, 8.

Represented by 33 specimens: Tapirapoan, 10; Utiarity, 16; Urucúm, 2; Tres Burity, 2; San Juan, 2; Vilhema, 1.

This species is strikingly similar in coloration to *Zygodontomys cherriei* (Allen), from Costa Rica — so strongly that when specimens of both are mixed in a tray they are not readily separable without recourse to the labels. On careful comparison there is a slight average difference in the yellowish brown tone of the upperparts, while the underparts are nearly pure gray in *cherriei* and usually faintly to strongly washed with fulvous in *tapirapoanus*. The feet, however, in the former are light brown and in the latter dark brown. There is also considerable difference in size, *cherriei* being much larger than *tapirapoanus*, as shown especially by the skulls. In *tapirapoanus* the palatal foramina are narrower and longer and extend further back, reaching nearly to the middle of m^1 instead of only to the end of the first third.

Zygodontomys tapirapoanus resembles *Akodon arviculoides montensis* Thomas, from Sapucay, Paraguay, with a series of which my specimens have been compared, but is paler and grayer and much smaller. Six adult topotypes of *montensis* (in U. S. National Museum, measured by William Foster, the collector) measure as follows: Total length, 233 (215–245); head and body, 132 (120–137); tail vertebræ, 105 (97–108); hind foot (s. u.), 23.7 (23–25). (Compare with the measurements of 6 old adults, from Utiarity and Tres Burity, given above.)

Molossus cherriei sp. nov.

Type, ♀ ad., No. 36669, Tapirapoan, Matto Grosso, Brazil, Jan. 13, 1914; George K. Cherrie (No. 17664), for whom the species is named. (Roosevelt Brazilian Expedition.)

A small form of the *Molossus pygmæus* group, with very short pelage and very dark coloration.

Pelage short, very fine and velvety, the hairs on back only about 2 mm. in length. Upperparts blackish brown with a faint tone of dark chestnut, the hairs uniformly colored nearly to the point of insertion; underparts slightly paler, the hairs without trace of light tips; ears, membranes and feet black.

Total length (from a well made skin), 79 mm.; head and body, 56; tail, 23; forearm, 33; third metacarpal, 34; lower leg, 11; foot, 7. The skull is unfortunately lost.

Represented by only the type, taken at Tapirapoan, a few miles northeast of Cuyabá, on the Rio Sepotuba, the point of departure of the Roosevelt Expedition on the overland trip to the Rio Roosevelt.

This species appears to be, so far as can be determined from a single specimen, one of the smallest forms of the *M. pygmæus* group, with extremely short, velvety pelage, and a very small amount of whitish at the base of the hairs. Its nearest geographical allies are *M. burnesi* Thomas of Cayenne.

and specimens from Daule, Ecuador, formerly provisionally referred by me to *M. pygmæus* Miller, of which the type and only known specimen is from Curaçoa. *M. tropidorynchus* (Gray), from Cuba, and *M. coibensis* Allen, from Panama, are too obviously distinct to require special consideration.

Molossus daulensis sp. nov.

Molossus pygmæus Allen (not of Miller), Bull. Amer. Mus. Nat. Hist., XXXV, p. 125, May 11, 1916.

Type, No. 36257, ♂ ad., Daule, Ecuador, April 23, 1913; William B. Richardson.

Pelage soft, 5 or 6 mm. in length on the back, the basal half or two-thirds white. Upperparts light seal brown with a chestnut tone; underparts slightly lighter; ears, feet and membranes blackish brown.

Total length (approximate, from a poorly made skin), 80 mm.; head and body, 50; tail, 30; forearm, 36; third metacarpal, 38; tibia, 12; foot, 9.

Skull, total length, 16.2; condylobasal length, 15; lacrymal breadth, 5; zygomatic breadth, 10; mastoid breadth, 8; breadth of braincase, 8.3; maxillary toothrow, 4.8.

Represented by 5 specimens from Daule and 1 from Puna Island.

The skull has about the same volume as that of *M. coibensis* but differs from it greatly in shape, being much longer and narrower and much lighter, the sagittal crest thinner and lower, in correlation with the more delicate structure, the braincase more inflated and the postorbital region less constricted. The coloration is similar to that of the dark phase of *M. coibensis*, lighter and less glossy than in *M. cherriei* from Matto Grosso, and with the basal half or more of the pelage white, as in *pygmæus* and *coibensis*.

59.9,32A:14.85,7

Article XXVIII.— THE AUDITORY OSSICLES OF *APLODONTIA.*

By T. D. A. Cockerell.

The genus *Aplodontia* alone represents in the modern fauna an ancient series of Sciuromorph rodents which, in one of its families, dates back as far as the Wasatch Eocene.[1] It seemed probable that the ear-bones, hitherto undescribed, would throw interesting light on the relationships of the genus; so I applied to Dr. J. A. Allen, who has very kindly loaned a couple of skulls of *Aplodontia pacifica* Merriam, from the vicinity of Tillamook, Oregon, for the purposes of this investigation.

The characters found are as follows:

Skull remarkably wide; auditory bullæ rather small, with long (about 12 mm.) tubular meatus, approximately at right angles to the longitudinal axis of the skull. The surface of the bulla is only moderately convex, and consists of very dense bone; but within there is a coarse honey-comb-like structure, with numerous transverse bony lamellæ dividing the middle ear into compartments, with the small cochlea suspended, as it were, in the midst. The condition is not unlike that found in *Ochotona.*

Malleus with a large rounded head (without the pointed process seen in *Marmota*), from which descends, beak-like, a strong processus cephalicus, bounding exteriorly a translucent plate or lamina, as in the Myomorpha. The processus gracilis, which should bound the lamina below, is scarcely developed, the edge being almost wholly without thickening. Cephalic peduncle broad and stout; no orbicular apophysis. Manubrium well developed, blade-like, narrowly spatulate apically, the entire substance thick and dense, not bimarginate. Processus brevis low and obtuse. Processus muscularis apparently represented by a slight angle nearly halfway down the manubrial margin, as is common in Sciuridæ.

Incus with a broad head, the interval between the articular surfaces marked by a conical prominence (not always so high as shown in the figure); processus brevis like that of Sciuridæ, but rather short; processus longus stout, truncate, apically curved, but without any sylvian apophysis.

Stapes with a large thick head, oval seen from above; crura diverging, leaving a large subtriangular opening on each side; stapedius muscle inserted a short distance below the head; on the side opposite the stapedius muscle the foot-plate is produced far beyond the crus, and there is at the base of the crus a large round pit or aperture, which is translucent like the flat inner surface of the foot-plate between the crura.

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[1] Matthew. Bull. Amer. Mus. Nat. Hist., XXVIII (1910), pp. 69–71.

Reviewing the above, it may be said that the incus and stapes, while possessing marked characters, are not fundamentally different from those of the Sciuridæ. The malleus, on the other hand, possesses the lamina and processus cephalicus so characteristic of the Myomorpha, but lacks the orbicular apophysis.

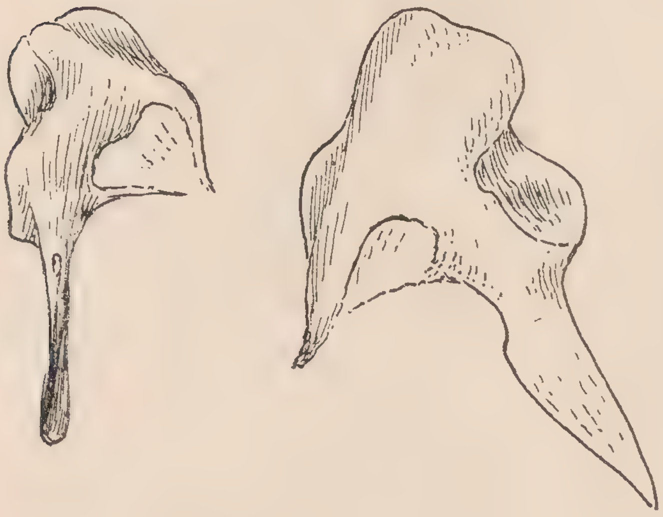

Fig. 1.

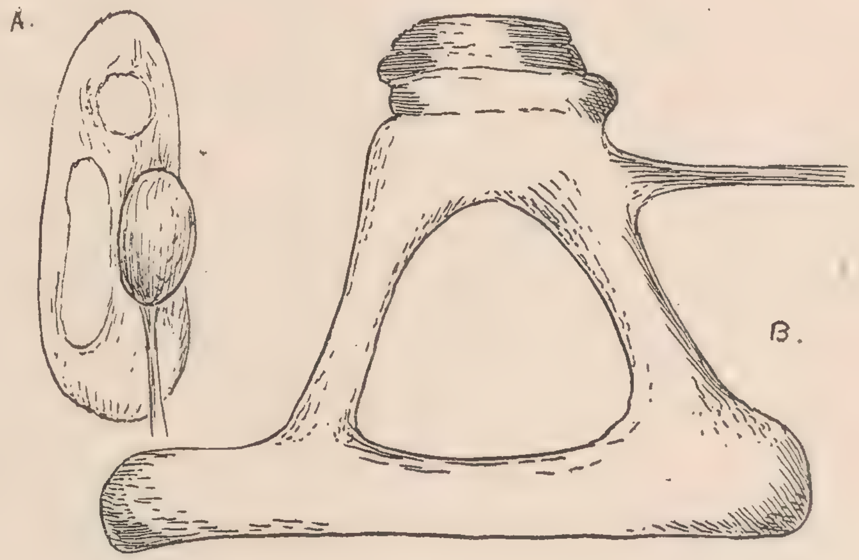

Fig. 3.

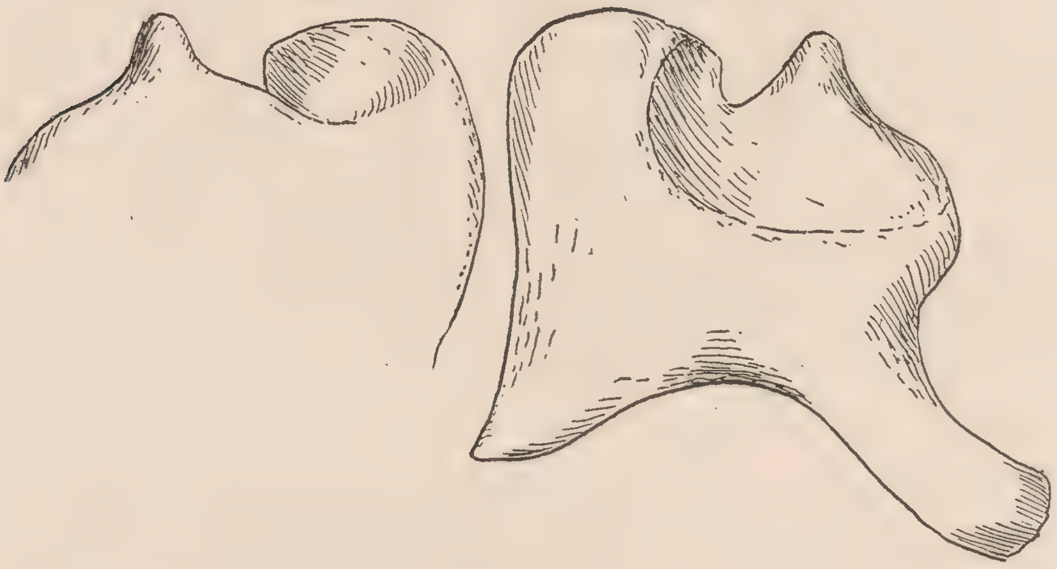

Fig. 2.

Fig. 1. *Aplodontia pacifica.* Malleus. Two views.
Fig. 2. " " Incus.
Fig. 3. " " Stapes. A, from above. B, from the side.

It does not appear that on account of the malleus we are to dissociate *Aplodontia* from the Sçiuromorphs, but we recall the argument[1] in favor of the view that the lamina is an ancient structure. According to this theory, the presence of cephalic process and lamina exactly fits in with the view that *Aplodontia* is (barring certain obvious specializations) the most primitive living Sciuromorph.

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[1] Bull. Amer. Mus. Nat. Hist., XXXIII, p. 350

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Article XXIX.—ON *DYSITHAMNUS MENTALIS* AND ITS ALLIES.

By W. E. Clyde Todd.

Introduction.

Among the various genera of the Formicariidæ which have always given trouble to students of this difficult family *Dysithamnus* admittedly holds a conspicuous place. For not only are the limits of the genus in dispute, but also certain of the species are involved in such confusion that scarcely any two authors agree regarding their treatment. Much of this confusion centers around a group of forms of which *Dysithamnus mentalis* is the earliest known, and it is the object of the present paper to endeavor to clear up, as nearly as may be, the existing uncertainty surrounding their status, relationships, and nomenclature, so as to reach a clearer understanding of the entire group from the systematic standpoint. Begun originally in an effort to identify certain specimens in the collection of the Carnegie Museum, this study has been made possible only through the courtesy of Dr. Frank M. Chapman, who has very generously placed at the writer's disposal the entire series of this group in the collection of the American Museum of Natural History, and upon which he was expecting to work himself. Important material has also been received for use in this connection from the U. S. National Museum, the Academy of Natural Sciences of Philadelphia, and the Field Museum of Natural History, to the authorities of which institutions the writer takes this opportunity of returning his thanks for favors extended. In all no less than two hundred and seventy-six specimens have been available, including several types, and representing more or less adequately all of the recognized forms.

The forms of this particular group, of which *D. mentalis* is the earliest although not the best known, agree in their small size and plain coloration, without any spots on the pileum or breast. The sexes are unlike, the males having the pileum dark gray, the wings externally margined with olivaceous, and their coverts tipped with white, while in the females the pileum is rufescent, the wings are plain, the upper parts are olivaceous, and the under parts washed with dull buffy or yellowish. There is much variation in color in the males of the several forms, and while it is a far cry from the olive and yellow *D. mentalis* to the gray and white *D. extremus*, there is between these two a series of forms so variously intermediate in coloration that it is a difficult matter to decide just where the lines of specific distinction should be drawn. Females are naturally more alike than are males, and it is not always possible to discriminate them with certainty. One of the interesting results of the present study has been the discovery that the plumage of the immature bird (not the "juvenal," but what Dr. Dwight would call the "first winter" dress), when this differs from that of the adult, affords an unmistakable indication of the derivation of the form under consideration. Apparently the failure to appreciate the significance of age variation in this group has been responsible for a part at least of the confusion, while among other contributing causes may be mentioned paucity and inaccessibility of material, poor condition of specimens, inadequacy of published descriptions, and ignorance of the work of earlier authors.

The distribution of the various forms of this group presents some very interesting problems. As yet there is no indisputable evidence that more than one form occurs in a given locality, although there are indications that such may be the case. The known range of some forms is very restricted indeed, while that of others covers an immense area by comparison. One of the most curious cases is that of *D. mentalis,* the various South American races of which have a discontinuous distribution. This may, of course, be apparent rather than real, and be due merely to our imperfect knowledge of the intervening areas, but it is difficult to account for the seeming absence of the species in certain regions which have been well worked. Again, the Central American race of this same species, *D. mentalis septentrionalis,* has been recorded from Guatemala and Costa Rica as not uncommon, but has never been detected in the intermediate countries of Salvador, Honduras, and Nicaragua. *D. semicinereus* has an extensive distribution in the Andean region from Colombia to Bolivia, but is replaced in the Western Andes and Cauca region of Colombia by a closely allied but perfectly distinct species, *D. extremus,* which is itself in certain respects very similar to the far-removed *D. affinis spodionotus* of British Guiana. *D. andrei,* heretofore known only from Trinidad and Tobago, proves to extend to the mainland of Venezuela, and to approximate (if it does not entirely surround) the British Guiana form aforesaid. In altitudinal distribution the various forms range from sea-level up to about seven thousand feet.

Sclater, in Part I of his 'Synopsis of the American Ant-birds' (Proceedings Zoological Society of London, 1858, 202–254) recognized only two species of this group, *D. mentalis* and his own lately described *D. semicinereus.* A few months later he described a bird from the Derby Museum, and supposed to be from Bolivia, which he referred to Tschudi's *Thamnophilus olivaceus.* No other general review of the genus appeared until 1890, when

Sclater again treated it at length in Volume XV of the 'Catalogue of the Birds in the British Museum,' recognizing four forms of the *mentalis* group, which he ranked as species. Under the head of *D. semicinereus*, however, he confused no less than three distinct forms, while his *D. olivaceus* is clearly the *D. affinis* of Pelzeln, described in 1869. Dr. J. A. Allen, writing in 1893, "lumped" all the forms of this group which had been described up to that time under the earliest name, stating that he was unable to distinguish more than a single species. Mr. Harry C. Oberholser was apparently the first to point out the distinctness of the Matto Grosso bird from that of Colombia, and to anticipate the correct application of Pelzeln's name *affinis*. His suspicions were confirmed in 1905 by Messrs. von Berlepsch and Hellmayr, who were able to settle the matter through actual examinations of the types both of *D. affinis* and of *Thamnophilus olivaceus* Tschudi, the latter proving to be an earlier name for *Dysithamnus semicinereus* Sclater. The latest synopsis of the group is by Mr. Robert Ridgway, in Part V of his 'Birds of North and Middle America.' Here all the forms except *D. affinis* are reduced to subspecies of *D. mentalis*, obscuring their real relationships and necessitating a highly artificial arrangement. In the key which follows herewith an effort has been made to place the various forms in what is believed to be a more natural sequence, and while the characters relied on for their separation may seem subtle and of little moment in some cases, their value becomes very evident in a series, and ought to suffice for discriminating the forms in question under such circumstances.

The measurements used in the present paper are all in millimeters, and that for the bill is in every case the length of the exposed culmen. Unless otherwise stated, they are based on a series of ten specimens of each sex. The names of colors are those given in Mr. Ridgway's 'Color Standards and Color Nomenclature.'

Key to the Species and Subspecies of the Dysithamnus mentalis Group.

Based on Adult Males Only.

A. Pileum and hindneck slate gray, contrasting with the olivaceous of the back; posterior under parts straw yellow, at least medially; throat whitish, in decided contrast.
  a. Breast straw yellow, like the abdomen...... *Dysithamnus mentalis mentalis.*
  a′. Breast differently colored from the abdomen.
    b. White of throat purer.
      c. Breast white medially like the throat; yellow of abdomen more extended over the sides...... *Dysithamnus mentalis æquatorialis.*
      c′. Breast shaded with grayish and pale olivaceous; yellow of abdomen more restricted.............. *Dysithamnus mentalis lateralis.*

b′. White of throat grayer.
c. General coloration darker........*Dysithamnus mentalis suffusus.*
c′. General coloration paler........*Dysithamnus mentalis septentrionalis.*
A′. Pileum and hindneck gray or slate gray, not sharply contrasting with the color of the back; posterior under parts not straw yellow.
a. Throat and breast heavily clouded with pale slate gray.
b. Lower back and flanks strongly washed with olivaceous. *Dysithamnus semicinereus.*
b′. Lower back and flanks gray, with no olivaceous wash. *Dysithamnus extremus.*
a′. Throat and breast white, faintly shaded with neutral gray (or if more strongly shaded with gray, the flanks with no olivaceous wash).
b. Posterior upper parts suffused with deep olive gray.
c. Abdomen white medially, the flanks washed with deep olive buff. *Dysithamnus affinis affinis.*
c′. Abdomen buffy yellow medially, the flanks strongly tinged with dark olive buff........................*Dysithamnus affinis emiliæ.*
b′. Posterior upper parts with no olive gray shade.
c. General coloration darker; breast shaded with gray. *Dysithamnus affinis spodionotus.*
c′. General coloration paler; breast nearly white, like the throat. *Dysithamnus andrei.*

Dysithamnus mentalis mentalis (*Temminck*).

Myothera mentalis Temminck, Pl. Col., II, 1823, text to pl. 179, fig. 3 ([Curytiba], Brazil; orig. descr.; type in coll. Vienna Museum).

Myiothera poliocephala Wied, Beiträge Naturg. Bras., III, 1831, 1098 (Brazil; orig. descr.; type in coll. Am. Mus. Nat. Hist.).

Dysithamnus mentalis Cabanis, Arch. f. Naturg., XIII, i, 1847, 223 (references).— Bonaparte, Consp. Av., I, 1850, 199, excl. syn. part (references; range [error]). — Sclater, Proc. Zool. Soc. London, 1858, 221, part (diag.; references; range; excl. Bolivian and Peruvian localities and references).— Cabanis and Heine, Mus. Hein., II, 1859, 14 (Brazil; references).— Sclater, Cat. Am. Birds, 1862, 177 (Brazil and Bolivia; syn.).— Euler, Journ. f. Orn., XV, 1867, 402 (Cantagallo, Brazil; nesting).— von Pelzeln, Orn. Bras., ii, 1869, 79 (Rio Janeiro, Registo do Sai, Curytiba, and Rio Paraná [i. e., Rio Grande], Brazil).— Gray, Hand-List Birds, I, 1869, 311, excl. syn. part (ref. orig. descr.; syn.; range).— Sclater and Salvin, Nom. Av. Neotrop., 1873, 71 (range).— Giebel, Thes. Orn., II, 1875, 73, part (syn.)— Cabanis, Journ. f. Orn., XXII, 1874, 86 (Cantagallo, Brazil).— Heine and Reichenow, Nom. Mus. Hein. Orn., 1883, 127 (Brazil).— von Berlepsch and von Ihering, Zeitsch. Ges. Orn., II, 1885, 150 (Taquara do Mundo Novo, Rio Grande do Sul, and Laguna, Santa Catharina, Brazil; plum.).— Allen, Bull. Am. Mus. Nat. Hist., II, 1889, 250, 276 (crit. on type of *Myiothera poliocephala* Wied).— Sclater, Cat. Birds Brit. Mus., XV, 1890, 221 (São Paulo and Pelotas, Rio Grande do Sul, Brazil; descr.; syn.).— Salvin and Godman, Biol. Centr.-Am., Aves, II, 1892, 207, in text (southeast Brazil; crit.).— Kœnigswald, Journ. f. Orn., XLIV, 1896, 365

(Estado de São Paulo, Brazil: references; range).— VON IHERING, Rev. Mus. Paulista, III, 1898, 239 (Tieté and Iguapé, São Paulo, Brazil; references); IV, 1900, 158 (Cantagallo, Brazil).— VON IHERING, Ann. Est. Rio Grande do Sul, XVI, 1900, 130 ([Taquara do] Mundo Novo, Brazil).— EULER, Rev. Mus. Paulista, IV, 1900, 68 (Brazil; descr. nest and eggs).— VON IHERING, Rev. Mus. Paulista, IV, 1900, 250 (Euler's reference).— DUBOIS, Syn. Av., I, iii, 1900, 180 (range; ref. orig. descr.).— SALVADORI, Boll. Mus. Zool. Torino, XV, No. 378, 1900, 18 (Tebicuari, Paraguay; crit.).— SHARPE, Hand-List Birds, III, 1901, 18 (range).— OBERHOLSER, Proc. U. S. Nat. Mus., XXV, 1902, 128 (Sapucay, Paraguay; crit.).— VON IHERING, Rev. Mus. Paulista, V, 1902, 316 (São Paulo, Brazil).— HAGMANN, Bol. Mus. Gœldi, IV, 1904, 25 (Wied's reference), 52 (Burmeister's reference), 81 (Pelzeln's reference).— VON IHERING, Rev. Mus. Paulista, VI, 1904, 330 (Paraguay; syn.).— VON BERLEPSCH and HELLMAYR, Journ. f. Orn., LIII, 1905, 15, in text, part (Brazil and Bolivia, in geog. distr.; crit.).— VON IHERING, Aves do Brazil, 1907, 202 (Estado de São Paulo, Ypiranga, Tieté, Itararé, Avanhandava, Barretos, Bebedouro, Itapura, Baurú, Iguapé, and Alto da Serra e Ubatuba, Brazil; range; references).— HELLMAYR, Nov. Zool., XV, 1908, 69, in text (crit.).— CHUBB, Ibis, 1910, 521 (Sapucay, Paraguay; references; crit.).— DABBENE, An. Mus. Nac. Buenos Aires, (3), XI, 1910, 284 (faunal distribution).— BRABOURNE and CHUBB, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Formicarius mentalis GRAY, Gen. Birds, I, 1849, 209 (ref. orig. descr.; syn.).

Dasythamnus mentalis BURMEISTER, Syst. Ueb. Thiere Bras., III, 1856, 82 (Brazil; references; descr.).

Thamnophilus (*Silvestrius*) *flavescens* BERTONI, Aves Nuevas del Paraguay, 1901, 136 ("Alto Paraná, entre 25° y 28° de latitud"; orig. descr.).— ARRIBALZAGA, An. Mus. Nac. Buenos Aires, VII, 1902, 367 (crit.).— RICHMOND, Auk, XIX, 1902, 416 (ref. orig. descr.).

Dysithamnus mentalis mentalis RIDGWAY, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54 (diag.; syn.; range), 57 (meas.).— HELLMAYR and VON SEILERN, Arch. f. Naturg., 1912, ii, 121, in text (Rio Janeiro, Brazil; crit.).

Description.— Adult male: pileum and hindneck pure dark gray (between slate gray and slate color), in evident contrast with the dull grayish olive green of the rest of the upper parts, including the outer margins of the wings and tail; rectrices dusky (except as aforesaid), with indistinct and very small whitish tips; remiges dusky centrally, with inner margins straw yellow; greater wing-coverts and primary coverts dusky, with slight outer margins of dull grayish olive green; lesser and middle coverts black, narrowly tipped with white, the greater coverts also indistinctly white-tipped; edge of wing white; scapulars tinged with gray, and with narrow outer margins of white; orbital and auricular regions slate black, contrasting with the paler (dark gull gray) color of the lores and sides of the head and neck otherwise; throat dull white; rest of under parts, as well as under wing-coverts, straw yellow, the sides and flanks faintly shaded with olivaceous; "iris brown."

Female not seen, but described by Mr. Hellmayr as having the throat less whitish and the under parts deeper yellow than in *D. mentalis lateralis*, which see.

Measurements.— Male (two specimens): wing, 57–58; tail, 42–43; bill, 13; tarsus, 19–20.

Range.— Southern Brazil, from São Paulo and Rio de Janeiro to Rio Grande do Sul, and west to Paraguay.

Remarks.— This species was described by Temminck in 1823 from a male specimen collected by Natterer at Curytiba, Brazil, and still preserved in the Museum at Vienna. Eight years later Maximilian, Prince of Wied, redescribed it under the name *Myiothera poliocephala,* no definite locality being mentioned. Although Wied's types, now before me through the courtesy of the authorities of the American Museum of Natural History, are at present entirely unrecognizable, owing to their long exposure to the light as mounted specimens, his description is so very explicit that it was readily referred to Temminck's bird. When Cabanis instituted the genus *Dysithamnus* in 1847 he very properly placed this species therein, where by common consent it has since remained, although Gray placed it in *Formicarius,* and Señor Bertoni, unaware of the work of previous authors, redescribed it as the type of a new subgenus, *Thamnophilus* (*Silvestrius*) *flavescens.*

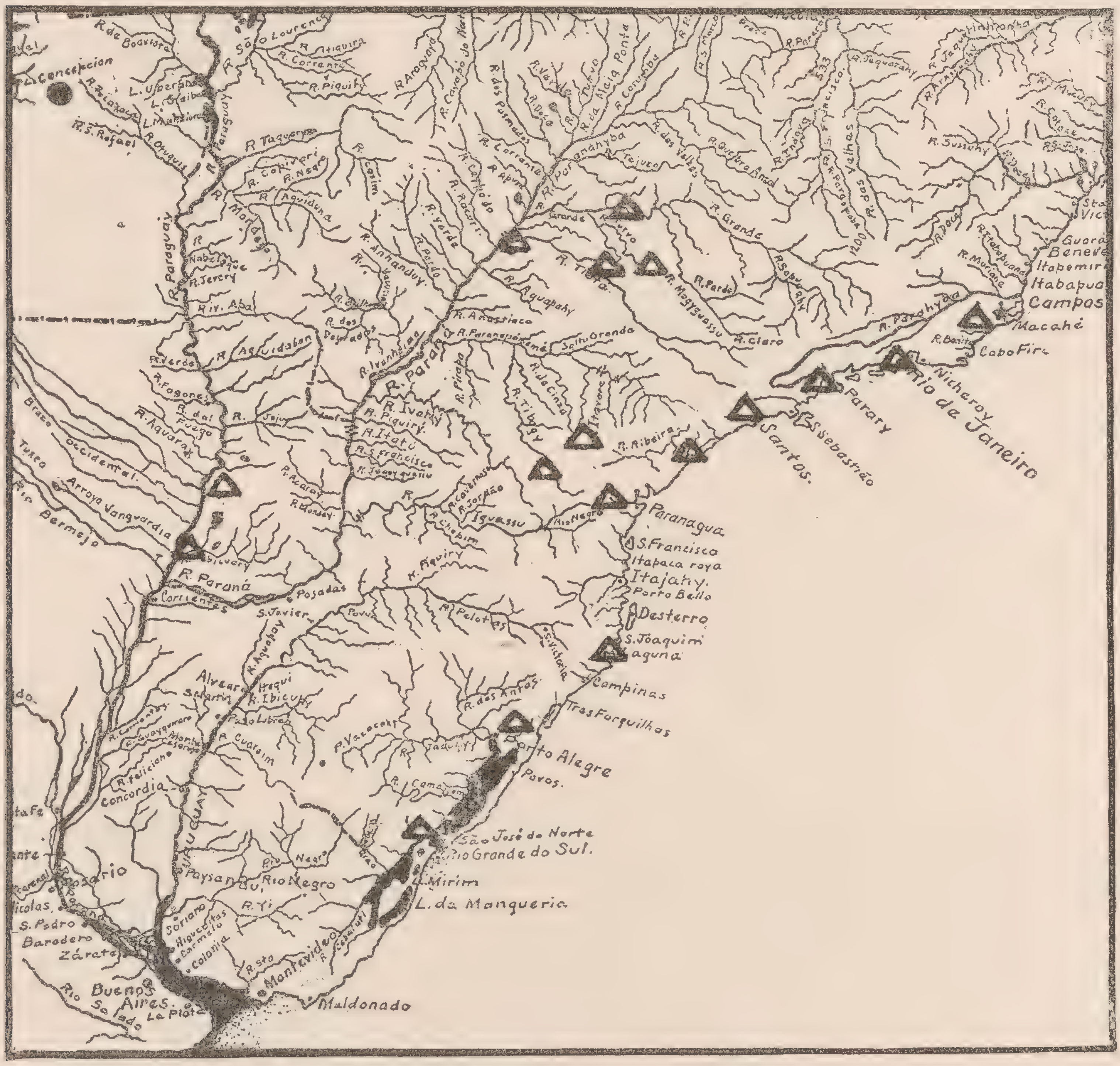

Fig. 1. Distribution of △ *Dysithamnus mentalis mentalis.*

Most of the earlier records are for localities on or near the coast of southern Brazil, but Natterer obtained specimens on the Rio Grande, and more recently it has been traced still farther into the interior, to the Rio

Paraná and Rio Paraguay. Sclater, indeed, refers to a specimen from Bolivia, but no definite locality is specified, although it is quite possible that it may reach the southern confines of that country. Most of the confusion in regard to the present form has arisen from the circumstance of its having been mixed up, not only with several closely allied geographical races in other parts of tropical America, but also with certain other forms which are perfectly distinct specifically. As yet we have no positive evidence that its range impinges upon that of *D. affinis*, its nearest neighbor geographically, but it is entirely probable that future research will show this to be the case. According to Euler it is a bird of the low brushy undergrowth, building a deep cup-shaped nest of fine vegetable fibers and rootlets, suspended from the fork of a branch, like a vireo, and laying spotted eggs.

Specimens examined.— "Brazil," 2 (types of *Myiothera poliocephala* Wied); Alto de Serra [e Ubatuba], 1. Paraguay: Sapucay, 1. Total, 4.

Dysithamnus mentalis æquatorialis subsp. nov.

Type, No. 129,686, Collection American Museum of Natural History, adult male; Zaruma, Province del Oro, Ecuador, September 25, 1913; William B. Richardson.

Subspecific characters.— Adult male similar to the same sex of *Dysithamnus mentalis mentalis*, but white of the throat extended over the breast, leaving only the abdomen yellow.

Measurements.— Male (two specimens): wing, 61–62; tail, 40–41; bill, 13; tarsus, 19.5–20. Female (two specimens): wing, 58–60; tail, 39–40; bill, 13–13.5; tarsus, 18–19.

Range.— Known only from the type-locality, in extreme southwestern Ecuador.

Remarks.— This subspecies is based on a series of six specimens, all from one locality in Ecuador. Where its range meets that of *D. mentalis* on the one hand and of *D. m. lateralis* on the other can only be conjectured. It is quite possible that some of the records referred to *D. semicinereus* may really belong here, immature specimens of the latter greatly resembling the present form. The series includes two immature males, both with brownish wings, like those of the female, while in the younger one the crown still retains some of the brownish feathers of the juvenal dress, and the plumage in general is like that of the adult female. The latter I am unfortunately unable for want of material to compare with the same sex of typical *mentalis*. They may readily be separated from females of *lateralis*, however, by their more olivaceous color above and by the paler brown of the pileum, while the throat is somewhat tinged with yellowish, and the under parts are purer yellow, with less dark suffusion on the sides and flanks.

Specimens examined.— Ecuador: Zaruma, Province del Oro (6000 feet), 6.

Dysithamnus mentalis lateralis subsp. nov.

Dysithamnus semicinereus (not of Sclater, 1855) Sclater and Salvin, Proc. Zool. Soc. London, 1868, 168 (Caripé, Venezuela), 628 (San Esteban, Venezuela).— Sclater and Salvin, Nom. Av. Neotrop., 1873, 71, part (Venezuela, in geog. distr.).— Sclater and Salvin, Proc. Zool. Soc. London, 1875, 235 (Merida, Venezuela).— Taczanowski, Orn. Perou, II, 1884, 29, part (Venezuela; crit.).— Sclater, Cat. Birds Brit. Mus., XV, 1890, 221, part (San Esteban, Caracas, and Caripé, Venezuela).— Sharpe, Hand-List Birds, III, 1901, 18, part (Venezuela, in geog. distr.).

Dysithamnus mentalis var. *semicinereus* Dubois, Syn. Av., I, iii, 1900, 180, part (Venezuela, in geog. distr.).

Dysithamnus mentalis (not *Myothera mentalis* Temminck) von Berlepsch and Hellmayr, Journ. f. Orn., LIII, 1905, 15, in text, part (Puerto Cabello, Venezuela).— von Berlepsch, Nov. Zool., XV, 1908, 150, footnote, part (Puerto Cabello, Venezuela).

Dysithamnus mentalis mentalis Hellmayr, Nov. Zool., XIII, 1906, 3, 32 (Tobago; Cumaná, Venezuela; faunal distribution).

Dysithamnus mentalis semicinereus Ridgway, Bull. U. S. Nat. Mus., No. 50, V, 1911, part (Venezuela, in geog. distr.), 57 (meas.).

Dysithamnus mentalis olivaceus (not *Thamnophilus olivaceus* Tschudi) Hellmayr and von Seilern, Arch. f. Naturg., 1912, i, 121, excl. extralimital localities and references (Las Quiguas, La Cumbre de Valencia, Quebrada Secca, and Caripé, Venezuela; crit.).

Type, No. 36,914, Collection Carnegie Museum, adult male; Guarico, Estado Lara, Venezuela, February 13, 1911; M. A. Carriker, Jr.

Subspecific characters.— Adult male similar to that of *D. mentalis mentalis*, but colors of lower parts less pure and less sharply contrasted; the white of the throat more extended, and tinged with grayish posteriorly; the yellow of the lower breast and abdomen paler, duller, and more restricted; and the sides and flanks more extensively shaded with yellowish olive buff (this shading scarcely evident in typical *mentalis*). "Iris brown; feet plumbeous; bill black above, plumbeous below." Adult female: pileum and hindneck deep Brussels brown; back deep olive; tail deep medal bronze or brownish olive, and inner secondaries margined externally with the same color, the outer ones and the wing-coverts buffy olive, all the remiges with internal margins of yellowish white; orbital ring white; lores, faintly indicated superciliaries, and sides of the head and neck dull buffy olive, the auriculars darker, more brownish, with often a whitish lower margin; throat dull white; breast, sides, and particularly the flanks, more or less deeply washed with dark olive buff; abdomen and under wing-coverts straw yellow, with the under tail-coverts paler; "iris brown; feet plumbeous; bill black above, plumbeous below."

Measurements.— Male: wing, 59–65 (average, 61); tail, 38–42 (40); bill, 14–15 (14.7); tarsus, 18–21 (19.5). Female (seven specimens): wing, 57–62 (60); tail, 35–41 (38); bill, 14–16 (15); tarsus, 18–20 (19).

Range.— Northern Venezuela, eastward to the island of Tobago, and westward to the Andes of Merida. One record also for the valley of the upper Magdalena River in Colombia.

Remarks.— The description of the female is drawn up from two specimens from the type-locality, secured in February, and which, being in fine fresh plumage, are somewhat more richly colored than the remainder of the series. They are very close to the same sex of *D. semicinereus,* but differ in averaging less rufescent, more olivaceous, on the sides of the head, the back, and particularly the wings; the under parts, too, have less buffy shading on the throat and breast. Males are duller and paler below than in *D. m. æquatorialis;* the white of the throat is less extended; and the sides more decidedly washed with yellowish olive buff. Females of these two forms have already been compared under the head of *D. m. æquatorialis,* but owing to want of material I have been unable to compare females of the present form with those of *D. m. mentalis.* Messrs. Hellmayr and von Seilern remark that their Venezuelan females have a more whitish throat and paler yellow under parts than do specimens from Rio Janeiro.

Venezuelan specimens were originally referred by Sclater to his *D. semicinereus,* nor was the propriety of this reference seriously questioned until 1905, when Messrs. von Berlepsch and Hellmayr incidentally included specimens from Puerto Cabello with those from Brazil and Bolivia. The following year Mr. Hellmayr insisted that specimens from Tobago and Cumaná were clearly referable to the yellow-bellied *D. mentalis,* not to *D. andrei* of Trinidad. In 1912, however, Messrs. Hellmayr and von Seilern, with a series before them from the same localities as are represented in the material handled by the present writer, while carefully distinguishing their birds from typical *D. mentalis,* nevertheless placed them with the Colombian form, *D. "olivaceus,"* remarking that certain specimens from the respective regions were indistinguishable from each other. As will be shown beyond, this resemblance is due to differences in age being left out of consideration, although it is by no means impossible that some of the supposed specimens of *D. semicinereus* may really belong to the present form.

Although there can be no question as to the subspecific relationship existing between this form and true *mentalis,* their discontinuous distribution and wide separation are not so easily explained, since it is unlikely that the species has merely been overlooked in the intervening region, however imperfectly worked it still may be. Two females from Honda, on the upper Magdalena River, Colombia, unquestionably belonging to the present form, suggest that its range may invade that of *D. semicinereus,* and join that of *D. m. æquinoctialis* to the southward. It does not seem to be confined to the lower altitudes in any case.

Specimens examined.— Venezuela: Las Quiguas, 3; San Esteban, 1; El Hacha, 4; Aroa, 2; Guarico, 3; Sierra de Carabobo, 1; El Guacharo, 1. Colombia: Honda, 1. Total, 16.

Dysithamnus mentalis suffusus *Nelson.*

Dysithamnus mentalis suffusus Nelson, Smithsonian Misc. Coll., LX, No. 3, 1912, 10 (Mount Pirri, eastern Panama; orig. descr.; type in coll. U. S. National Museum).

Subspecific characters.— Adult male similar in general to that of *D. m. lateralis*, but general coloration decidedly darker; throat much darker and grayer; abdominal yellow more restricted anteriorly and laterally; breast and sides heavily washed with dull citrine (sometimes becoming buffy citrine on the flanks); and olivaceous of the back averaging darker. Female also differing in a similar way, the throat being duller white, and the breast and sides strongly shaded with buffy citrine; the upper parts, and especially the wings, averaging more rufescent.

Measurements.— Male: wing, 61–66 (average, 63.5); tail, 38–43 (40); bill, 15–16 (15.4); tarsus, 19–21 (20). Female: wing, 59–65 (61.5); tail, 38–41 (39.5); bill, 14–16 (15): tarsus, 19–20 (19.6).

Range.— Mountains of extreme eastern Panama, on the Colombian frontier.

Remarks.— In describing this form Mr. Nelson failed to compare it precisely with *D. m. septentrionalis,* with which it is obviously most closely related both genetically and geographically. It is by far the darkest of all the forms of this species, and cannot be confused with any of the South American races for this reason. Comparing males with a series of the same sex of *D. m. septentrionalis,* we find that while they are about the same above, they are much darker below, being washed with greenish rather than grayish, especially on the breast and sides. Moreover, the upper abdomen, which is usually whitish in *septentrionalis,* is always yellowish in the present form. Immature males are always brighter yellow below, as is shown by a considerable number of unquestionably immature examples. Females of the respective forms are more nearly alike, but in *suffusus,* as might be expected, the under parts are more strongly washed with dull citrine, giving a much darker general effect.

Several young birds in postjuvenal moult are available from Tacarcuna and Mount Tacarcuna, March 24 to April 14. These indicate that in juvenal dress the upper and under parts are of a rich bay color, the throat probably paler, while the wings and tail are practically the same as in the adult female.

Specimens examined.— Panama: Mount Pirri, 8; Tacarcuna, 23; east slope Mount Tacarcuna (4600 feet), 10. Total, 41.

Dysithamnus mentalis septentrionalis *Ridgway.*

Dysithamnus semicinereus (not of Sclater, 1855) Sclater and Salvin, Ibis, 1860, 399 (Choctum, Guatemala; crit.).— Salvin, Proc. Zool. Soc. London, 1867, 144 (Santa Fé, Veragua; crit.).— LAWRENCE, Ann. Lyc. Nat. Hist. N. Y., IX, 1868, 107 (Turrialba, Dota, Grecia, and Guiatil, Costa Rica).— FRANTZIUS, Journ. f. Orn., XVII, 1869, 305 (Costa Rica).— VON PELZELN, Orn. Bras., ii, 1869, 149, in text (Vera Paz, Guatemala; crit.).— SALVIN, Proc. Zool. Soc. London, 1870, 194 (Calovevora, Chitra, Calobre, and Volcan de Chiriqui, Veragua).— SCLATER and SALVIN, Nom. Av. Neotrop., 1873, 71, part (Central America to Mexico, in geog. distr.).— BOUCARD, Proc. Zool. Soc. London, 1878, 60 (Naranjo, Costa Rica).— ZELEDON, Cat. Aves Costa Rica, 1882, 12 (Costa Rica).— ZELEDON, Proc. U. S. Nat. Mus., VIII, 1885, 108 (Costa Rica).— ZELEDON, An. Mus. Nac. Costa Rica, I, 1887, 114 (Cartago, Turrialba, and Dota, Costa Rica).— SCLATER, Cat. Birds Brit. Mus., XV, 1890, 221, part (Central American localities and references).— SALVIN and GODMAN, Biol. Centr.-Am., Aves, II, 1892, 206, part (Choctum and Chisec, Vera Paz, Guatemala; Central American localities and references; descr.; habits); I, 1904, xxv (Guatemala, Costa Rica, and Panama, in geog. distr.).— UNDERWOOD, Av. Costarriquena, 1899, 9 (Costa Rica.)— SHARPE, Hand-List Birds, III, 1901, 18, part (Central America, in geog. distr.).— BANGS, Proc. New England Zool. Club, III, 1902, 41 (Boquete, Panama, 4000 to 5000 feet).

Dysithamus [sic] *semicinereus* BOUCARD, Ann. Soc. Linn. Lyon, new series, XXV, 1878, 48 (Guatemala).

Disithamnus [sic] *semicinereus* CHERRIE, Expl. Zool. Costa Rica, 1890–91, 1893, 41 (Rio Platinar [near Buenos Aires de Terraba], Costa Rica).

Dysithamnus mentalis (not *Myothera mentalis* Temminck) ALLEN, Bull. Am. Mus. Nat. Hist., V, 1893, 118, part (Guatemala and Costa Rica; crit.).

Dysithamnus mentalis var. *semicinerea* DUBOIS, Syn. Av., I, iii, 1900, 180, part (Guatemala, in geog. distr.).

Dysithamnus mentalis septentrionalis RIDGWAY, Proc. Biol. Soc. Washington, XXI, 1908, 193 (Choctum, Vera Paz, Guatemala; orig. descr.; type in coll. U. S. National Museum; range).— FERRY, Field Mus. Orn. Series, I, 1910, 271 (Guayabo, Costa Rica).— CARRIKER, Ann. Carnegie Mus., VI, 1910, 606 (Guayabo, Naranjo de Cartago, Buena Vista, La Lagunaria de Dota, El General, Cariblanco de Sarapiquí, Cachí, Juan Viñas, and Las Mesas, Costa Rica; Costa Rican references; habits).— RIDGWAY, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54, 55 (diag.; descr.; meas.; Central American references and localities).— NELSON, Smithsonian Misc. Coll., LV, No. 3, 1912, 10, in text (crit.).

Subspecific characters.— Adult male similar to that of *D. m. suffusus*, but much paler beneath, the throat averaging whiter, the breast more purely gray; the yellow below paler, and more restricted in front, usually leaving the upper abdomen medially white; and the dark shading on the breast and sides less evident. Females are lighter colored below than in *suffusus*.

Measurements.— Male: wing, 59–64 (average, 62); tail, 36–40 (38); bill, 14–15 (14.6); tarsus, 18–20.5 (19.5). Female: wing, 58–63 (60); tail, 36–40 (38); bill, 14–16 (15); tarsus, 18–20 (19).

Range.— Vera Paz, Guatemala; Costa Rica and Panama. (No records for Salvador, Honduras, or Nicaragua).

Remarks.— Discovered by Salvin in 1860 at Choctum, Vera Paz, Guatemala, and subsequently found at numerous localities in Costa Rica and Panama by Salvin and others, this bird was considered to be the same as that from "Bogotá," which had been given the name *Dysithamnus semicinereus* by Sclater a few years previously, until Mr. Ridgway pointed out its distinctive characters in 1908. Indeed, it is a curious fact that it is much closer to *D. semicinereus* in general characters than is the geographically intermediate *D. m. suffusus* of eastern Panama. This is indicated

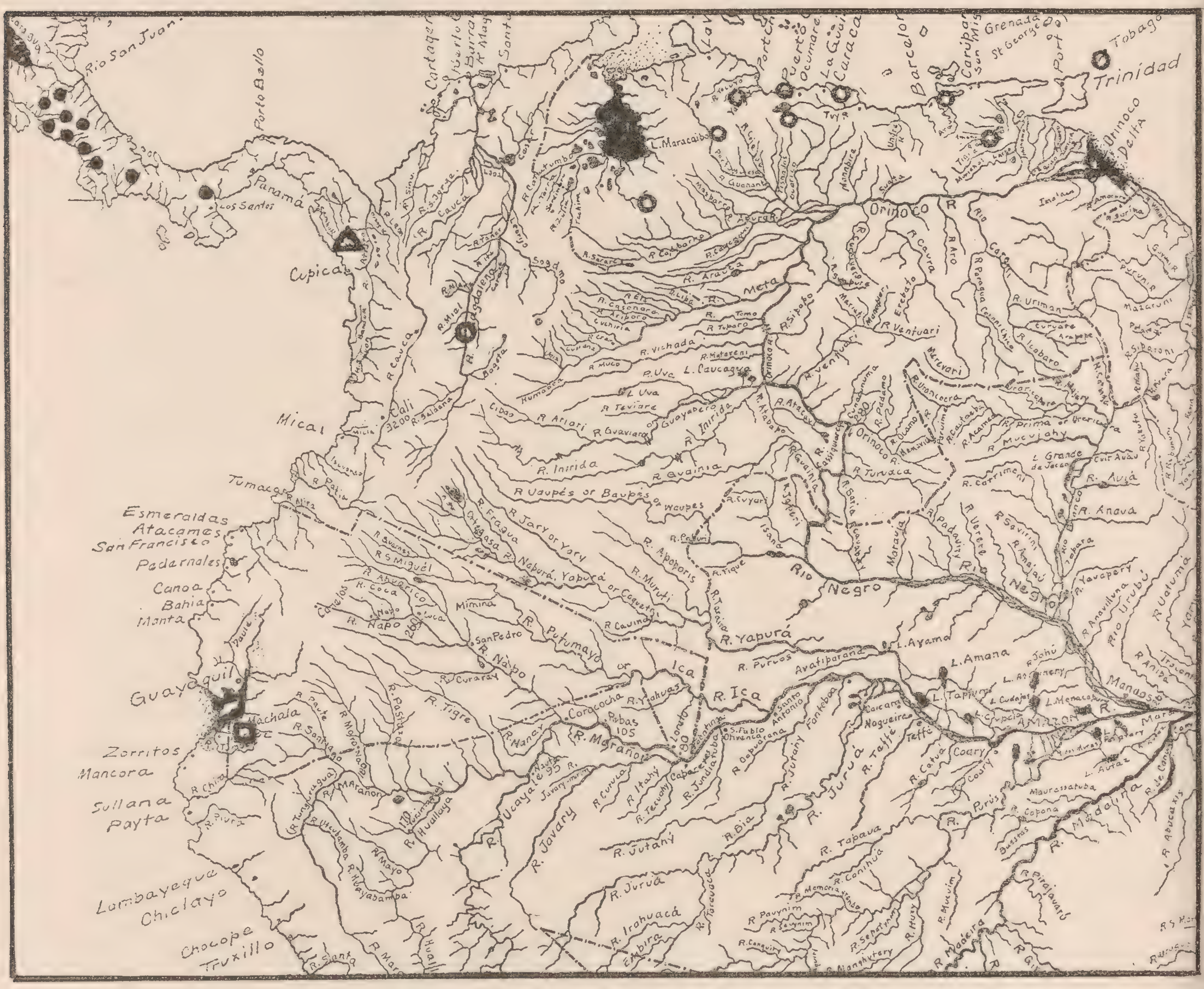

Fig. 2. Distribution of subspecies of *Dysithamnus mentalis.*

● Dysithamnus mentalis septentrionalis.
△ Dysithamnus mentalis suffusus.
○ Dysithamnus mentalis lateralis.
☐ Dysithamnus mentalis æquatorialis.

by the lighter colors below, and in particular by the frequent restriction of the yellow to the middle and lower abdomen, leaving a white area on the upper abdomen, just below the breast. As shown by Mr. Ridgway, immature birds lack this character, having the entire abdomen yellow. Females of the two forms are very difficult to separate. Compared with *D. m. lateralis,* males have darker, more grayish throats, and the yellow color is more restricted, but females are not so readily distinguished, averaging merely a little yellower below. Its real affinities are clearly with *D. mentalis* rather than with *D. semicinereus,* agreeing as it does with the former in distinctly olivaceous back and yellowish abdomen. I am unable to appreciate any constant characters by which the Guatemalan specimens may be distinguished from those from Costa Rica and Panama, as intimated by Mr. Nelson. I think the paler color of the type may be due to the age of the skin; at any rate, it would require a much larger series of specimens from both regions to reach a positive conclusion on this point.

Specimens examined.— Guatemala: (no locality specified) 3. Costa Rica: Juan Viñas, 2; Las Mesas, 1; Turrialba, 1; Dota, 1; Navarro, 1; Naranjo, 1; Buena Vista, 1; Guayabo, 4; Lagunaria, Santa Maria de Dota, 1; El General, 5. Panama: Cerro Azul, 2; Cana, 1. Total, 24.

Dysithamnus semicinereus *Sclater.*

Thamnophilus mentalis (not *Myothera mentalis* Temminck) D'Orbigny and Lafresnaye, Syn. Av., in Guer. Mag. de Zool., 1837, ii, 12, excl. syn. (Yungas, Bolivia).— D'Orbigny, Voy. Am. Mer., Oiseaux, 1844, 177, excl. syn. part (Yungas, Bolivia; descr.; syn.).— Tschudi, Arch. f. Naturg., X, i, 1844, excl. syn. part (Peru; references).— Tschudi, Fauna Peruana, Aves, 1845–6, 173 (Peru; descr.).

Thamnophilus olivaceus (not *Tamnophilus olivaceus* Vieillot, 1825) Tschudi, Arch. f. Naturg., X, i, 1844, 278 (Peru; orig. descr.; type in coll. Museum Neuchâtel).— Tschudi, Fauna Peruana, Aves. 1845–6, 174, pl. 11, fig. 1 (Peru; descr.; crit.). — Allen, Bull. Am. Mus. Nat. Hist., V, 1893, 119, in text (syn.; crit.).

Dysithamnus olivaceus Cabanis, Arch. f. Naturg., XIII, i, 1847, 224 (ref. orig. descr.; crit.).— Bonaparte, Consp. Av., I, 1850, 199 (ref. orig. descr.; range).— Sclater, Proc. Zool. Soc. London, 1860, 89 (Nanegal, Ecuador).— von Pelzeln, Orn. Bras., ii, 1869, 149, in text (crit.).— Sclater and Salvin, Nom. Av. Neotrop., 1873, 71 (range).— Giebel, Thes. Orn., II, 1875, 73 (ref. orig. descr.). — Taczanowski, Orn. Perou, II, 1884, 28, excl. syn. part (Peru; descr.; references; crit.; *ex* Tschudi).— Sharpe, Hand-List Birds, III, 1901, 19, part (range).— von Berlepsch and Stolzmann, Ornis, XIII, 1906, 93 (Santa Ana and Idma, Peru; crit.), 116 (Huaynapata, Peru; crit.; plum.).— Menegaux, Mission pour la Mesure d'un Arc de Méridien Equatorial en Amérique du Sud, IX, i, 1911, B 32 (Gualea, Ecuador; Tschudi's reference; range).— Brabourne and Chubb, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Formicarius olivaceus Gray, Gen. Birds, I, 1849, 209 (Tschudi's reference).

Dysithamnus semicinereus Sclater, Proc. Zool. Soc. London, 1855, 90, pl. 97 ("Bogotá," Colombia; orig. descr.; types in coll. British Museum), 147 ("Bogotá," Colombia; ref. orig. descr.); 1858, 66 (Rio Napo, Ecuador), 222 (diag.; ref. orig. descr.; range); 1860, 278 (Babahoyo, Ecuador; crit.).— Sclater, Cat. Am. Birds, 1862, 177 ("Bogotá," Colombia; Pallatanga and Babahoyo, Ecuador; syn.).— PELZELN, Orn. Bras., ii, 1869, 149, in text, part (range; crit.).— GRAY, Hand-List Birds, I, 1869, 311 (ref. orig. descr.; range).— SCLATER and SALVIN, Nom. Av. Neotrop., 1873, 71, part (range).— GIEBEL, Thes. Orn., II, 1875, 73 (syn.; = *D. mentalis* Cabanis [error!]).— TACZANOWSKI, Proc. Zool. Soc. London, 1874, 530 (Amable-Maria, Monterico, and Paltaypamba, Peru); 1879, 232 (Tambillo, Peru); 1882, 30 (Cococho, Huambo, and Chirimoto, Peru).— VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1883, 564 (Chimbo, Ecuador; crit.); 1884, 302 (Chimbo, Ecuador).— TACZANOWSKI, Orn. Perou, II, 1884, 29 (Huambo and Santa Rosa, Peru; New Granada; references; crit.; habits; excl. extralimital localities).— TACZANOWSKI and VON BERLEPSCH, Proc. Zool. Soc. London, 1885, 68 (Chimbo, Ecuador). — SCLATER, Cat. Birds Brit. Mus., XV, 1890, 221, part (descr.; localities in Colombia, Ecuador, and Peru).— SALVIN and GODMAN, Biol. Centr.-Am., Aves, II, 1892, 206, part (ref. orig. descr.; range; habits, *ex* Stolzmann); I, 1904, xxv, part (South Am., in geog. distr.).— VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 381 (La Gloria and Garita del Sol, Peru; crit.). — SHARPE, Hand-List Birds, III, 1901, 18, part (range).— GOODFELLOW, Ibis, 1902, 64 (Mount Pichincha, Ecuador).

Dysithamnus mentalis SCLATER, Proc. Zool. Soc. London, 1858, 221, part (Bolivian and Peruvian localities and references); 1860, 67 (Pallatanga, Ecuador).— SCLATER and SALVIN, Proc. Zool. Soc. London, 1879, 624 (Yungas, Bolivia, *ex* D'Orbigny).— ALLEN, Bull. Am. Mus. Nat. Hist., V, 1893, 118, part ("Bogotá," Colombia; crit.).

(?)*Dysithamnus tambillanus* TACZANOWSKI, Orn. Perou. II, 1884, 30 (Tambillo, Peru; orig. descr.; type in coll. Warsaw Museum; habits; crit.).— SCLATER, Cat. Birds Brit. Mus., XV, 1890, 219, footnote (ref. orig. descr.).— ALLEN, Bull. Am. Mus. Nat. Hist., V, 1893, 120, in text (crit.).— SHARPE, Hand-List Birds, III, 1901, 19 (ref. orig. descr.; range).— BRABOURNE and CHUBB, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Dysithamnus mentalis var. *semicinerea* DUBOIS, Syn. Av., I, iii, 1900, 180, part (ref. orig. descr.; range).

Dysithamnus mentalis var. *tambillana* DUBOIS, Syn. Av., I, iii, 1900, 180 (Peru; ref. orig. descr.).

Dysithamnus olivaceus semicinereus OBERHOLSER, Proc. U. S. Nat. Mus., XXV, 1902, 129, in text ("Bogotá," Colombia; range; crit.).

Dysithamnus mentalis olivaceus VON BERLEPSCH and HELLMAYR, Journ. f. Orn., LIII, 1905, 14 (syn.; crit.).— HELLMAYR, Nov. Zool., XIII, 1906, 32, in text (crit.).— HELLMAYR and VON SEILERN, Arch. f. Naturg., 1912, i, 121, part ("Bogotá," Colombia, Ecuador and Peru; crit.).

Dysithamnus mentalis semicinereus RIDGWAY, Proc. Biol. Soc. Washington, XXI, 1908, 193, in text (crit.).— RIDGWAY, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54, 55 (diag.; references; range), 57 (meas.).— HELLMAYR and VON SEILERN, Arch. f. Naturg., 1912, i, 121, in text (range, *ex* Ridgway; crit.).

Description. Adult male: pileum, hindneck, and upper back blackish slate, passing into dark olive gray on the middle back, rump, and upper tail-coverts; tail dusky black, with very small whitish tips (sometimes wanting), and externally margined with dark olive gray or iron gray; remiges dusky, externally edged with dark olive gray, and internally with pale yellowish white or primrose yellow, which is also the color of the under wing-coverts; lesser and middle wing-coverts black, tipped with white; greater coverts dusky, edged with grayish or dark olive gray, and tipped with white (more or less distinctly); sides of head and neck slate gray, the loral region and auriculars darker, blackish slate; anterior under parts indistinctly clouded with pale slate gray, especially the breast and sides, leaving the throat and (often) the upper abdomen (medially) paler, more whitish; lower abdomen, under tail-coverts, and especially the flanks, strongly washed with greenish (vetiver green); "iris deep ashy; bill dark; feet plumbeous" (Taczanowski).

Adult female: pileum Brussels brown, the hindneck paler, passing into deep olive on the back, rump, and upper tail-coverts; tail mummy brown; wings dusky, the upper coverts and remiges margined externally with Dresden brown, the outer primaries with buckthorn brown; middle and greater coverts usually indistinctly tipped with paler brown; inner webs of remiges pale yellowish white, like the under wing-coverts; lores dull whitish; orbital ring white; sides of head suffused with brownish and buffy; under parts dull white, more or less suffused and clouded with deep or dark olive buff, especially on the breast, sides, and under tail-coverts, the abdomen usually more or less strongly tinged with primrose yellow or colonial buff; "iris deep ashy; bill dark [under mandible paler]; feet plumbeous" (Taczanowski).

Measurements.

	Wing.	Tail.	Bill.	Tarsus.
Ten males from Colombia	(61–69) 65	(38–45) 41	(14–15) 14.7	(19–20.5) 19.7
Ten males from Ecuador	(57–62) 60	(34–38) 36.5	(14–15) 14.5	(18–20) 19
One male from Peru	69	46	16	18.5
One male from Bolivia	58	37	15	19
Ten females from Colombia	(60–65) 63	(38–43) 40.5	(14–16) 15	(18–21) 19.5
Eight females from Ecuador	(55–59) 57	(35–37) 36	(14.5–15) 14.8	(17–19) 18.3
Two females from Bolivia	58	(35–37) 36	13.5	(17–19) 18

Range.— Andean Region of Colombia (except Western Andes), Ecuador, Peru, and Bolivia, from near sea-level up to about seven thousand feet.

Remarks.— In juvenal dress this species is probably rich brown in color, as indicated by No. 121,877, Collection American Museum of Natural History (Buena Vista, Colombia, March 1), which still retains a few feathers of this plumage on the scapulars. In immature dress the male has the whole back decidedly olivaceous, with the pileum dark grayish, usually with brownish feathers intermixed; the throat and breast are white, with little grayish suffusion, and the rest of the lower parts are dull primrose yellow; the wings are like those of the adult female, except that the lesser and middle coverts are often more advanced toward the adult male pattern. At this stage the bird is strikingly similar to *D. mentalis,* with which it might easily be confused. A study of the present series renders it fairly certain, however, that individuals of both sexes showing a decided amount of yellow color on the under parts are young birds. The amount of white tipping on the lesser coverts in the male also varies greatly, being entirely absent in some specimens, and very prominent in others, the white extending also to the outer margin of the scapulars.

Specimens from Ecuador and Bolivia average a little smaller and perhaps a trifle paler below than those from Colombia, but the rough condition of the skins forbids satisfactory comparison. At any rate, I cannot see my way clear to recognition of such a southern form, especially as the only available Peruvian skin is at the maximum of size in the entire series, and is otherwise absolutely indistinguishable from Colombian birds. This specimen comes from the same general region as the type of *Dysithamnus tambillanus* Taczanowski — a species which I am unable to make out exactly, but which in view of the variation observable in the series before me I doubt will prove to be anything more than an individual variant of the present form.

The characters of the young bird and of the female would suggest that *D. semicinereus* had been derived from some form of *D. mentalis,* and it is certainly very close in certain respects to *D. mentalis septentrionalis,* as already pointed out. Otherwise, however, it is much nearer *D. affinis,* and in my judgment should stand as a distinct species, intermediate between these two, the more so as it is altogether probable that its range coincides to some extent at least with *D. mentalis lateralis* and *D. m. æquinoctialis* on the one hand, while not yet known to touch that of *D. affinis* on the other. The adult male differs from that of *D. affinis* in the darker grayish suffusion of the under parts, the different color of the flanks (vetiver green instead of deep olive buff), and the much greater extent of the olivaceous wash on the back. Females, too, are likewise very different, being olivaceous rather than rufescent above, and the under parts more olive yellowish, less purely buffy.

D'Orbigny's bird from the Province of Yungas, Bolivia, which he erroneously identified with Temminck's *Myothera mentalis,* clearly belongs here instead, and is the earliest record I can find for the present bird. A few years later, in 1844, Tschudi described and figured a bird from Peru as *Thamnophilus olivaceus* — a name which has given much trouble to systematists, since it proved impossible to identify it certainly with any known species. In 1905, however, the type was examined by Messrs. von Berlepsch and Hellmayr, and found to be a young bird of the form described by Sclater in 1855 as *Dysithamnus semicinereus,* which name they accordingly relegated to synonymy. It appears, however, that Tschudi's name is preoccupied by *Tamnophilus olivaceus* Vieillot, 'Galerie Oiseaux,' I, 1825, 325, for a species of shrike, so that it will be necessary to revert to Sclater's name for the present species. Considerable uncertainty attaches to some of the references hereby provisionally ranged under this head, since without actual examination of the specimens upon which they were based it is impossible to be sure that they do not apply to some other form instead. Only one Peruvian specimen has been available, nor have I seen any from eastern Ecuador. Certain authors have called attention to variations obtaining in series from different parts of Peru, Ecuador, and Colombia respectively, and it may be that these were due to confusing one or more forms with each other.

Habits.— "I have encountered this bird at Huambo and have seen it at Santa Rosa (system of Huayabamba), at an altitude of 6000 feet, which appears to be its orographical limit. It is purely a forest bird, traveling in little bands, sometimes alone, sometimes with wandering parties [of other birds]. They generally fly very low, sometimes quite near the ground, like the *Pithys,* when they accompany the traveling ants. Its voice resembles that of *D. tambillanus,* and is often heard in the depths of the forests. It appears to be the males that sing and respond to one another. Often I have deceived them, imitating their notes, and they would approach me, replying. They have still another call-note: *cirrr,* like that of the *Myrmotherula menetriesii.* In the stomach of one of these birds I found seeds and the remains of insects." — Translation of Stolzmann, in Taczanowski, 'Orn. Perou,' II, 1884, 30.

Specimens examined.— Colombia: La Frijolera, 5000 feet, Antioquia, 2; "Bogotá," 5; east of Palmira, 6800 feet, 7; La Candela, 6500 feet, Huila, 5; near San Agustin, 5000 feet, Huila, 1; Andalucia, Huila, 5000 feet, 1; Buena Vista, above Villavicencio, 4500 feet, 12. Ecuador: Bucay, Guayas, 975 feet, 2; Gualea, 1; Junction Rio Chanchan and Rio Chiguancay, 2000–2500 feet, 7; Esmeraldas, 2; Rio de Oro, Manavi, 6; Chone, Manavi, 1; Santa Rosa, Province del Oro, 2; Naranjo, Province del Guayas, 1. Peru: Moyobamba, 1. Bolivia: Todos Santos, 1300 feet, 5; Rio Surutu, 1; Santa Cruz de la Sierra, 1; Rio Yapacani, 1. Total, 64.

Dysithamnus extremus sp. nov.

Dysithamnus semicinereus (not of Sclater, 1855) SCLATER and SALVIN, Proc. Zool. Soc. London, 1879, 525 (Concordia, Antioquia, Colombia).

Type, No. 111,887, Collection American Museum of Natural History, adult male; Salencio, Nóvita trail, altitude 5500 feet, Western Andes, Cauca, Colombia, December 10, 1911; Arthur A. Allen and Leo E. Miller.

Description.— Adult male: above slate color, the pileum darker, more blackish slate; rectrices dusky black, externally slate color, with slight whitish tips; remiges dusky, margined externally with vetiver green, the inner ones (more broadly) with slate color; inner margins of the remiges (except the outermost) pale yellowish white;

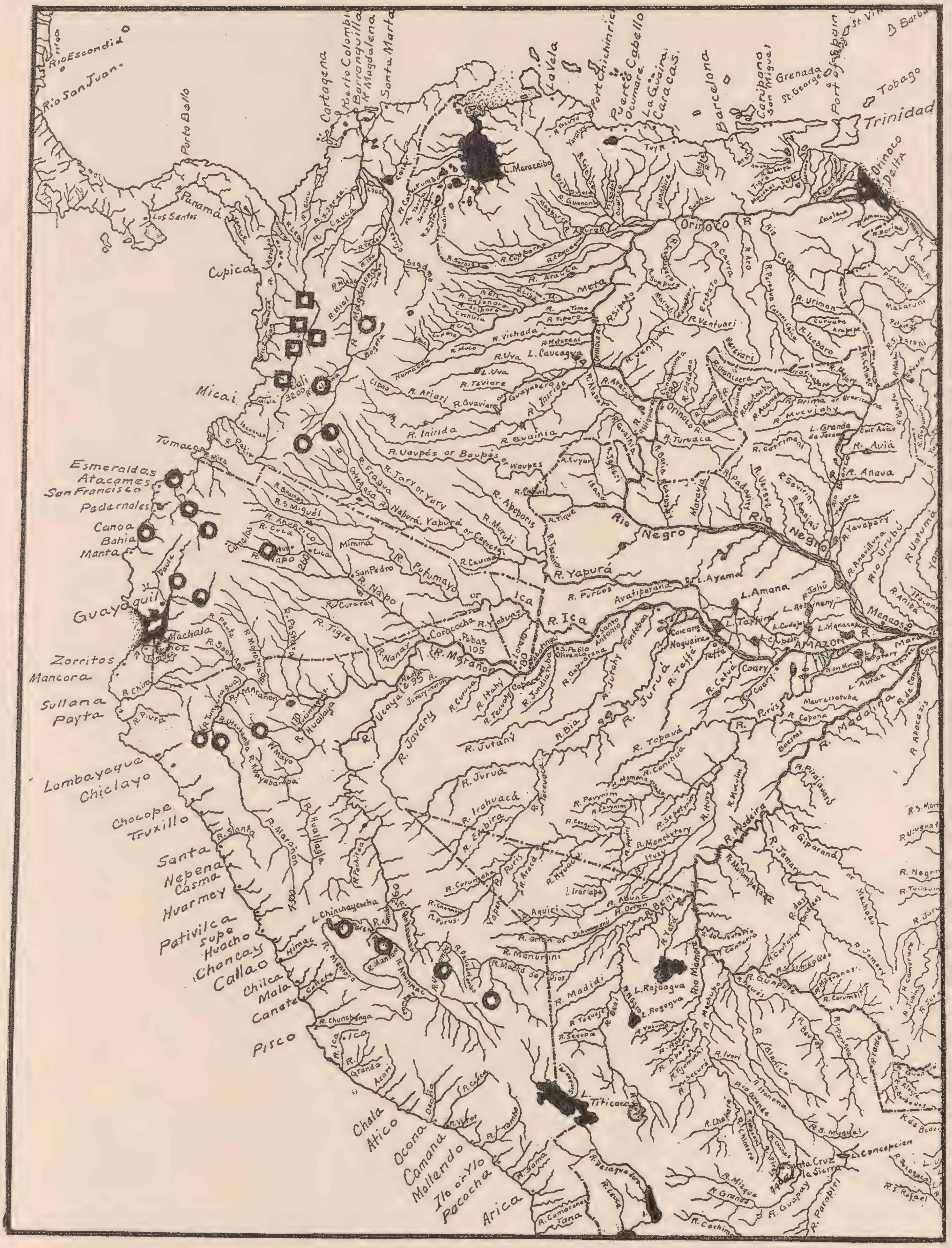

Fig. 3. Distribution of □ *Dysilhamnus extremus*; ○ *Dysilhamnus semicinereus*.

lesser and middle wing-coverts black, tipped with white; greater coverts slate color, tipped with white, and the outermost margined externally with white; primary-coverts dull slate color or dull greenish externally, narrowly tipped with white; under wing-coverts white, or white mottled with slate color; outer scapulars frequently margined with white externally; sides of the head and neck slate color, the lores and auriculars darker, more blackish slate; under parts whitish, heavily and irregularly clouded with slate gray, especially on the breast and sides; "iris dark brown; feet bluish gray [*i. e.*, plumbeous]; bill black above, gray below" (Palmer).

Adult female: pileum Brussels brown, passing into Saccardo's olive on the back, rump, and upper tail-coverts; tail mummy brown; wings dusky, margined externally with buffy citrine, the wing-coverts indistinctly tipped with buckthorn brown; under wing-coverts and inner margins of the remiges pale yellowish white; orbital ring white; lores and sides of the head mottled with brownish and buffy; under parts dull whitish, irregularly clouded with pale buffy olive, the abdomen sometimes more yellowish, the buffy olive shading heavier on the breast and sides; under tail-coverts chamois-color.

Immature male: not distinguishable in any way from the adult male of *D. semicinereus.*

Measurements.— Male: wing, 63–66 (average, 64.7); tail, 39–43 (41); bill, 14–15.5 (14.7); tarsus, 18.5–21 (20). Female: wing, 60–63 (61); tail, 37–42 (39); bill, 14–14.5 (14.9) tarsus, 19–20 (19.5).

Range.— Western Andes and Cauca region of Colombia, from Antioquia south to near the headwaters of the Cauca River.

Remarks.— Fully adult males of this very distinct form differ conspicuously from those of *D. semicinereus* in the pure dark gray color above, without any olivaceous tinge whatever, and also in the absence of any such color on the abdomen and flanks, these parts being heavily shaded with slate gray, like the breast, while the under tail-coverts also are grayish white, with no trace of olivaceous. Females are readily distinguishable from the same sex of *D. semicinereus,* showing as they do much less yellowish suffusion below, and being duller and more buffy, as in *D. affinis.* But immature males are so precisely like adult males of *D. semicinereus* that I can find no characters by which to distinguish them with any certainty. The clue to the real status of these specimens, which were at first presumed to belong to *D. semicinereus,* although coming from the same localities as the others, was furnished by a young male (No. 111,883, Collection American Museum of Natural History, Rio Frio, Cauca, Colombia, November 8, 1911), still retaining the brownish-edged wings of the juvenal dress (except the lesser and middle coverts, which have been renewed), and a few brownish feathers on the forehead. In this individual the flanks are colored as in *D. semicinereus,* but in immature birds of that species the posterior under parts are more or less yellow, as already pointed out.

This species is confined to the Western Andes and Cauca region of

Colombia, ranging from 2500 to 7000 feet. It is clearly an offshoot from *D. semicinereus* of the Central and Eastern Andes, but the material before me does not certainly indicate intergradation. There are, it is true, two female specimens from the Central Andes, taken at an altitude of 6800 feet east of Palmira, which might possibly be referred to the present form on account of their more buffy, less yellowish color below, but as none of the males from the same locality show any divergence in this direction I feel justified in referring the entire series to *D. semicinereus.* So far as I am able to discover there is but one published record probably pertaining to this interesting species, which adds another to the list of novelities hailing from western Colombia.

Specimens examined.— Colombia: near Jimenez, 2400 feet, 2; Mount Pavas, 4400 feet, 8; La Maria, Dagua Valley, 4700 feet, 2; San Luis, Bitaco Valley, 4400 feet, 1; San Antonio, 6600 feet, Cauca, 7; Las Lomitas, 5000 feet, Cauca, 7; Cauca, 1; Rio Frio, 3500 feet, Cauca, 5; Salento, 7000 feet, West Quindio Andes, Cauca, 2; Salencio, Nóvita trail, 5500 feet, Cauca, 3. Total, 38.

Dysithamnus affinis affinis *Pelzeln.*

Dysithamnus olivaceus (not *Thamnophilus olivaceus* Tschudi) (?)Sclater, Proc. Zool. Soc. London, 1848, 541, excl. syn. (Bolivia, crit.).— Sclater, Cat. Birds Brit. Mus., XV, 1890, 222, excl. syn. (Chapada, Matto Grosso, Brazil; descr.; crit.).

Dysithamnus affinis von Pelzeln, Orn. Bras., ii, 1869, 80, 149 (Villa Maria, Matto Grosso, Brazil; orig. descr.; type in coll. Vienna Museum; crit.).— Gray, Hand-List Birds, I, 1869, 311 (Brazil).— Giebel, Thes. Orn., II, 1875, 72 (ref. orig. descr.).— Sclater, Cat. Birds Brit. Mus., XV, 1890, 219, footnote (ref. orig. descr.).— Allen, Bull. Am. Mus. Nat. Hist., V, 1893, 120, in text (crit.).— Sharpe, Hand-List Birds, III, 1901, 19 (ref. orig. descr.; range).— Oberholser, Proc. U. S. Nat. Mus., XXV, 1902, 129, in text (crit.).— Hagmann, Bol. Mus. Gœldi, IV, 1904, 81 (Pelzeln's reference).— von Berlepsch and Hellmayr, Journ. f. Orn., LIII, 1905, 15 (syn.; crit.).— von Ihering, Aves do Brazil, 1907, 203 (references; range).— Ridgway, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54, 55 (diag.; syn.; range), 57 (meas.).— Brabourne and Chubb, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Dysithamnus mentalis (not *Myothera mentalis* Temminck) Allen, Bull. Am. Mus. Nat. Hist., V, 1893, 118, excl. extralimital localities and references (Chapada, Matto Grosso, Brazil; crit.).

Dysithamnus mentalis var. *affinis* Dubois, Syn. Av., I, iii, 1900, 180 (Villa Maria, Brazil [*ex* Pelzeln]).

Dysithamnus mentalis var. *olivacea* Dubois, Syn. Av., I, iii, 1900, 180, excl. syn. (Bolivia and Matto Grosso, Brazil [*ex* Sclater]).

Dysithamnus olivaceus olivaceus Oberholser, Proc. U. S. Nat. Mus., XXV, 1902, 129, in text (Matto Grosso, Brazil; range; crit.).

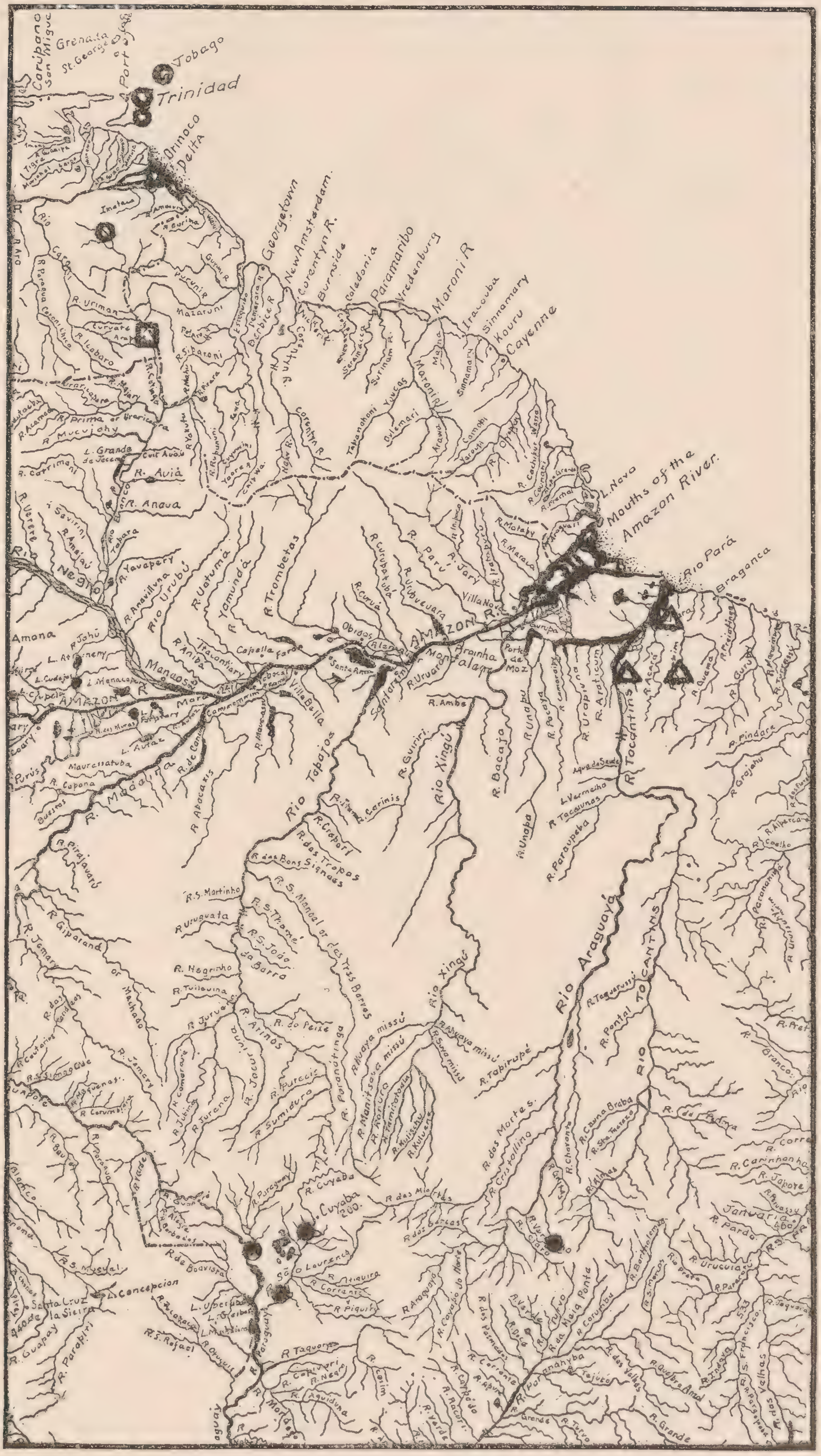

Fig. 4. Distribution of *Dysithamnus andrei* and the *D. affinis* group.

○ *Dysithamnus andrei.*

△ *Dysithamnus affinis emiliæ.*

□ *Dysithamnus affinis spodionotus.*

● *Dysithamnus affinis affinis.*

Dysithamnus affinis affinis HELLMAYR, Nov. Zool., XIII, 1906, 31, in text (diag.; range); XV, 1908, 14 (faunal distribution), 69 (Fazenda Esperança, Goyaz, Brazil; crit.).

Description.— Male: pileum blackish slate, fading into deep neutral gray on the nape and back, the lower back and rump shaded with deep olive gray; middle rectrices slate gray, the remainder dusky, with the outer webs slate gray, and all with small white tips; remiges dusky, externally margined with deep olive gray, the outermost with light olive gray; lesser and middle wing-coverts black, tipped with white; greater coverts dusky, more or less shaded with neutral gray, and narrowly tipped with white; under wing-coverts and inner margins of remiges white, sometimes very faintly tinged with yellowish; auricular patch blackish slate like the pileum, but contrasting with the paler gray of the postorbital region and sides of the neck generally; lores grayish white; throat, breast, and upper abdomen white, more or less washed with neutral gray, especially on the sides; flanks strongly washed with deep olive buff.

Female: pileum Brussels brown, brightest on the forehead, and fading on the hindneck into buckthorn brown, this passing gradually into the Saccardo's olive or light brownish olive of the back; tail sepia; wings externally Dresden brown, the middle and greater coverts with indistinct paler tips, the under wing-coverts and inner margin of the remiges pale yellowish white; lores and orbital ring pale; under surface dull white, irregularly shaded with dull buffy, especially laterally, passing into deep olive buff on the flanks; under tail-coverts cream buff.

Measurements.— Male (five specimens): wing, 61–64 (average, 63); tail, 40–42 (41); bill, 15–15.5 (15.1); tarsus, 19–20 (19.6). Female (five specimens): wing, 59–61 (60.5); tail, 38–41 (40); bill, 15–16 (15.4); tarsus, 19–20 (20).

Range.— Southwestern Matto Grosso, Brazil, east to central Goyaz, and probably west to Bolivia.

Remarks.— This species was accurately described by von Pelzeln as far back as 1869, but his description remained unrecognized for many years, even after the acquisition of a large series of specimens from a point near the type-locality had made the form well known. Dr. J. A. Allen, into whose hands this series first fell for study, referred them, together with specimens representing other forms of this group, to *D. mentalis.* (The reader is referred to his paper, above cited, for a very full account of the plumage-variations and characters shown by the series in question.) Meanwhile Sclater had referred a pair of birds from the same locality to the *Thamnophilus olivaceus* of Tschudi, and to this procedure Mr. Oberholser gave doubtful assent, pointing out the differences between the present form and *D. mentalis,* and strongly intimating that Tschudi's name would be found to apply to the *Dysithamnus semicinereus* of Sclater, leaving the name *affinis* for the species from southwestern Brazil. A few years later Messrs. von Berlepsch and Hellmayr, from actual examination of the types, determined this to be the fact, since which time this species at least has been eliminated from the confusion surrounding so many of the members of this group. Nearly all of the specimens known to science at present were collected at Chapada in southwestern Matto Grosso, Brazil, by Mr. Herbert H. Smith, while the type was taken by Natterer at Villa Maria, a locality not far distant. More recently it has been traced eastward as far as the State of Goyaz, and probably occurs throughout a large area in central Brazil and probably Bolivia also, although Sclater's records for this country are not above suspicion.

Specimens examined.— Brazil: Chapada, Matto Grosso, 47; San Lorenzo River, Matto Grosso, 1.

Dysithamnus affinis emiliæ *Hellmayr.*

Dysithamnus mentalis (not *Myothera mentalis* Temminck) Gœldi, Ibis, 1903, 499 (Rio Capim, Pará, Brazil).— von Berlepsch, Nov. Zool., XV, 1908, 150, footnote, part (Pará, Brazil).

Dysithamnus mentalis mentalis Hellmayr, Nov. Zool., XIII, 1906, 367 ([San Antonio do] Prata, Igarapé-Assu, Pará, Brazil; crit.).

Dysithamnus mentalis emiliæ Hellmayr, Abhand. K. Bayerischen Akad. Wiss. München, Math.-Phys. Kl., XXVI, 1912, 92 (San Antonio do Prata [type-locality], Rio Capim, and Flor do Prado, Pará, Brazil; orig. descr.; type in coll. Tring Museum).

Subspecific characters.— Adult male similar to that of *D. affinis affinis*, but differing conspicuously in its more purely white throat and breast, the gray shading being mostly confined to the sides, and by the buffy yellow tinge of the abdomen, while the flanks also are more strongly tinged with dark olive buff. The adult female is more yellowish, less buffy, below, especially on the abdomen medially, and more olivaceous, less brownish, above.

Measurements.— Male (one specimen): wing, 58; tail, 37; bill, 14; tarsus, 18.5. Female (one specimen): wing, 55; tail, 37; bill, 13; tarsus, 18.5.

Range.— Pará region, northwestern Brazil.

Remarks.— Mr. Hellmayr, in describing this form, compared it with *D. mentalis*, no doubt on account of its yellowish posterior under parts. I think, however, that it is better placed near *D. affinis*, which it resembles in its decidedly white throat and breast (with grayish sides), grayish back, and nearly white under wing-coverts and inner margins of the remiges. The three very indifferent skins at present before me show that it is a well-marked form in any case, and a larger series of well prepared specimens might readily suffice to establish it as a distinct species, intermediate in certain respects between *D. mentalis* and *D. affinis*, just as is the far removed *D. semicinereus*. An immature male has the back more suffused with greenish than the adult, while the throat and breast are less purely white.

Specimens examined.— Brazil: Baião, Rio Tocantins, 3.

Dysithamnus affinis spodionotus *Salvin and Godman.*

Dysithamnus spodionotus Salvin and Godman, Ibis, 1883, 211 (Mount Roraima, British Guiana; orig. descr.; type in coll. British Museum).— Salvin, Ibis, 1885, 424 (Mount Roraima, British Guiana, 3500 feet).— Reichenow and Schalow, Journ. f. Orn., XXXIV, 1886, 93 (reprint orig. descr.).— Sclater, Cat. Birds Brit. Mus., XV, 1890, 222 (Mount Roraima, British Guiana; descr.; ref.; crit.).— Sharpe, Hand-List Birds, III, 1901, 19 (range).— Brabourne and Chubb, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Dysithamnus affinis spodionotus von Berlepsch and Hellmayr, Journ. f. Orn., XXXIV, 1905, 15, in text (crit.).— Hellmayr, Nov. Zool., XIII, 1906, 2 (faunal distribution), 32, in text (diag.; range; crit.).

Dysithamnus mentalis spodionotus Ridgway, Bull. U. S. Nat. Mus., No. 50, V, 1911, 55 (diag.; ref.), 57 (meas.).

Subspecific characters.— Male differing from that of *D. affinis affinis* in its decidedly darker, deeper coloration throughout, the back being darker gray, with scarcely a trace of olivaceous tinge posteriorly; the under parts are more heavily shaded with gray; the flanks are scarcely different from the sides; and the lores are dark, like the pileum. The female differs, according to Mr. Hellmayr, in being more rufescent olive brown on the lower parts. (No females seen by the writer).

Measurements.— Male (one specimen): wing, 61; tail, 45; bill, 15; tarsus, 20. Female (*fide* Hellmayr): wing, 62–64; tail, 44–47.

Range.— Mount Roraima, British Guiana, 3500 feet.

Remarks.— Like the last, this also is a very strongly characterized form, perhaps entitled to rank as a species, although its relationship to *D. affinis affinis* is obvious. Immature males, indeed, resemble the latter very closely, having the lower back, rump, and flanks heavily washed with buffy brown — a different color, however, from that found in these parts in typical *affinis*. In its deep coloration it somewhat resembles *D. extremus*, but is not so dark, and the color is different, being neutral gray rather than slate color. It was discovered by Whitely on his expedition to Mount Roraima in 1881–82, and described the following year by Salvin and Godman, who compared it with *D. semicinereus*. It is not known except from the type-locality, nor from specimens collected by anyone other than Whitely himself.

Specimens examined.— British Guiana: Mount Roraima, 3.

Dysithamnus andrei *Hellmayr.*

Dysithamnus semicinereus (not of Sclater) Cory, Auk, X, 1893, 220 (Tobago).— (?)Dalmas, Mem. Soc. Zool. France, XIII, 1900, 141 (Tobago and Paria Peninsula, Venezuela).

Dysithamnus mentalis (not *Myothera mentalis* Temminck) Allen, Bull. Am. Mus. Nat. Hist., V, 1893, 118, part (Trinidad; crit.).

Dysithamnus mentalis spodionotus (not of Salvin and Godman) Chapman, Bull. Am. Mus. Nat. Hist., VI, 1894, 12, 50 (Trinidad; habits; crit.).

Dysithamnus affinis andrei Hellmayr, Nov. Zool., XIII, 1906, 2 (faunal distribution), 31 (Caparo, Trinidad; orig. descr.; type in coll. Tring Museum).— Cherrie, Mus. Brooklyn Inst. Sci. Bull., I, 1908, 365 (Carenage and Heights of Aripo, Trinidad; plum.).

Dysithamnus mentalis oberi Ridgway, Proc. Biol. Soc. Washington, XXI, 1908, 193 (Tobago; orig. descr.; type in coll. U. S. National Museum).— Ridgway, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54 (diag.; ref. orig. descr.; range), 57 (meas.).

Dysithamnus mentalis andrei Ridgway, Bull. U. S. Nat. Mus., No. 50, V, 1911, 54, 55 (diag.; ref.), 57 (meas.).

Dysithamnus oberi Brabourne and Chubb, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Dysithamnus andrei Brabourne and Chubb, Birds S. Am., I, 1912, 194 (ref. orig. descr.; range).

Description.— Male: pileum rather dark neutral gray, and auricular patch the same, contrasting with the paler gray of the sides of the head and neck; back and tail neutral gray; remiges dusky, margined externally with deep olive gray, internally with white (with a faint yellow tinge); lesser and middle wing-coverts black, tipped with white; greater series and primary-coverts gray like the back, externally margined and tipped with white; under wing-coverts pure white; lower parts white, shaded laterally with gray; "iris brown; feet plumbeous; bill black above, plumbeous below."

Female: pileum snuff brown, deepest in front, and passing into neutral gray, washed with grayish olive, on the back; tail sepia; wings externally pale tawny olive, the remiges inclining more to deep olive buff, the wing-coverts indistinctly tipped with paler buffy; under wing-coverts and inner margins of the remiges white or pale buffy white; orbital ring white; lores and slight postorbital streak pale buffy, with auriculars darker, more buffy brownish; under parts dull white, more or less washed with buffy, especially laterally, the flanks and under tail-coverts strongly washed with deep olive buff"; iris brown; feet plumbeous; bill black above, plumbeous below."

The immature male is like the adult, but the lower back, rump, upper tail-coverts, and flanks are more or less strongly washed with olivaceous, as in *D. a. affinis*, while the lower abdomen is pale yellowish white. At a still younger stage the bird more nearly resembles the adult female, as shown by a moulting specimen from Carenage, Trinidad (No. 31,671, Collection Carnegie Museum, August 17).

Measurements.— Male: wing, 61–65 (average, 62); tail, 38–43 (39); bill, 14–16 (14.8); tarsus, 18–20 (19). Female (nine specimens): wing, 57–62 (60); tail, 37–40 (39); bill, 14.5–16 (15.3); tarsus, 18–20 (19).

Range.— Islands of Tobago and Trinidad, and south to the headwaters of the Yuruani River, eastern Venezuela.

Remarks.— Contrary to Mr. Hellmayr's implication, adult males of *D. andrei* differ very decidedly from those of *D. a. affinis* in their more purely white under parts, with no olivaceous shading on the flanks; the upper parts, too, are more purely gray, and also without any olivaceous wash. Females, besides being much whiter below, with much less buffy suffusion, have the back decidedly grayish in tone as compared with those of *D. a. affinis*. From *D. a. spodionotus* both adult and immature males differ at a glance in being much whiter below and lighter, purer gray above, especially on the back. While the relationship of *andrei* with *affinis* and *spodionotus* is obvious, as maintained by Mr. Hellmayr, its characters are so strongly marked that I prefer to treat it as a distinct species, and I suspect that eventually it will be necessary to raise all the races of *D. affinis* here recognized to a similar rank.

The peculiarities of this form appear to have been remarked first by Dr. J. A. Allen, who nevertheless "lumped" all the various forms of this group under one name. Mr. Chapman referred these same specimens, collected by himself in Trinidad, and an addition to its avifauna, to *D. spodionotus* of British Guiana, but without having seen authentic specimens of the latter. It remained for Mr. Hellmayr to discriminate the form from both *affinis* and *spodionotus,* which he did in 1906. Two years later Mr. Ridgway described the Tobago bird under the name *Dysithamnus mentalis oberi,* and in his 'Birds of North and Middle America' he treated *andrei* also as a race of *D. mentalis.* The type of *oberi* is before me: while in very bad condition, it is unquestionably an immature male bird, in nowise different from Trinidad skins of the same age. A single female from Tobago (No. 30,624, Collection Field Museum of Natural History), which constitutes the sole basis of Mr. Cory's record above quoted, is also quite indistinguishable from Trinidad females, and I have accordingly no alternative but to consider *oberi* as a pure synonym of *andrei.* It may be well to call attention at this point, however, to the fact that Mr. Hellmayr refers two female individuals from this island (Tobago) to *D. mentalis* (*i. e., D. mentalis lateralis*), which is interesting, going to show that *D. andrei* is not conspecific with *D. mentalis.* Count Dalmas refers to specimens from Tobago as being like those from the Paria Peninsula, but without access to his specimens it is impossible to say positively to what species they belong. That *D. andrei* is not confined to Tobago and Trinidad, as heretofore supposed, but has in reality a much more extensive distribution, is indicated by a pair of birds, typical in every respect, in the collection of the Carnegie Museum, taken by Mr. M. A. Carriker, Jr., at El Callao, Venezuela, not far from Guacipati, on the Yuruani River, on May 24, 1910. Mr. Chapman, writing of its habits as observed in Trinidad, says that it "was found in small companies of not more than six individuals in the lower trees in the forests. They were generally associated with *Myrmotherula axillaris.* The call, of three or four low, sweet notes, is given by both sexes. It is Thrush-like in tone, and resembles the soft, querulous alarm notes of a Robin (*Merula migratoria*)."

Specimens examined.— Tobago, 2. Trinidad: Carenage, 2; Heights of Aripo, 8; Heights of Orepouche, 4; Santa Emilia Estate, Poole, 3; Caparo, 2; Princestown, 6. Venezuela: El Callao, 2. Total, 29.

59.9 (81)

Article XXX.— MAMMALS COLLECTED ON THE ROOSEVELT BRAZILIAN EXPEDITION, WITH FIELD NOTES BY LEO E. MILLER.

By J. A. Allen.

CONTENTS.

	Page
Introduction	559
Systematic List	562
Field notes, by Leo E. Miller	589

Introduction.

In 'Through the Brazilian Wilderness'[1] Colonel Roosevelt has given a most enlightening account of the country traversed by his expedition, with valuable natural history field notes, while Leo E. Miller, mammalogist of the expedition, has supplemented this account with a brief but most interesting description[2] of the country where most of the mammals were collected, namely, the vicinity of Trinidad and the Grand Chaco in Paraguay, and the country bordering the upper Rio Paraguay and the Rio Gy-Paraná in western Matto Grosso. The following is a list of the localities at which the mammals were collected, and the dates of collecting, as recorded in Mr. Miller's field register.

Localities at which Mammals were collected.

Rio de Janeiro, Brazil.
Trinidad, near Asuncion, Paraguay. Nov. 9–11 and 17, 1913.
Rio Negro, up the Rio Pilcomayo from Asuncion, Paraguay. Nov. 13–15.
Urucúm, near Corumbá, Matto Grosso. Nov. 26–Dec. 15.
Rancho Palmiras, Rio Taquary, Matto Grosso. Dec. 16–27.
São João, fazenda, on the Rio Cuyubá. Dec. 28–30.
Rio São Lorenço. Dec. 31–Jan. 2, 1914.
Porto Campo, on the Rio Sepotuba. Jan. 7–10.
Tapiropoan, on the Rio Sepotuba. (The starting point for the overland trip through Matto Grosso). Jan. 16–25.
Rio Mandioco, Matto Grosso. Jan. 26.

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[1] Through the Brazilian Wilderness. By Theodore Roosevelt. With illustrations from photographs by Kermit Roosevelt and other members of the Expedition. New York: Charles Scribner's Sons. 1914. 8vo., pp. xiv + 383, 49 full-page half-tone plates and 2 maps.

[2] The Roosevelt-Rondon Scientific Expedition, a review of its movements in South America in 1913–14 and of some of its zoölogical achievements. American Museum Journal, Vol. XV, Feb., 1915, pp. 49–63, with numerous half-tone illustrations.

Utiarity, Matto Grosso. Jan. 29–Feb. 5.

Guatsué, Matto Grosso. Feb. 7.

Maracana, Matto Grosso. Feb. 8.

Campos Novos, Matto Grosso. Feb. 16.

Vilhena, Matto Grosso. Feb. 18.

Tres Burity, Matto Grosso. Feb. 22–23.

José Bonefacio, Matto Grosso. Feb. 24.

Rio da Dúvida, Matto Grosso (= Rio Roosevelt). Feb. 27.

Barão Melgaço, Matto Grosso. (The end of the overland trip and the beginning of the trip down the Gy-Paraná.) March 3–8.

Urupá, Rio Gy-Paraná, Amazonas. March 15.

Calama, Rio Madeira, Amazonas (opposite the mouth of the Gy-Paraná). March 24–April 5.

Lower Solimoens, Amazonas (about fifty miles above the mouth of the river). April 16–30.

The collection of mammals includes nearly 450 specimens, representing 97 species. As indicated by the above list of localities, they were collected over a wide area, about 75 having been obtained in Paraguay, about 175 in what may be roughly designated as the Chapada region, about 40 at the junction of the Rio Gy-Paraná with the Rio Madeira, and about 50 on the lower Rio Solimoens.

The principal previous collections made within the same area are those of Johann Natterer, during the years 1825–1829, from which many new species were briefly described by Andreas Wagner in 1845,[1] and more fully elaborated in 1847–48.[2] In 1883 August von Pelzeln published a formal report on Natterer's collection of mammals,[3] as he had previously done (in 1868) for the birds.

In 1882–86, Herbert H. Smith spent several years at Chapada, Matto Grosso, making extensive collections of vertebrates and insects. The birds and most of the insects were later purchased by the American Museum of Natural History, but the mammals, reptiles and batrachians were purchased by Professor Cope and are now in the Museum of the Philadelphia Academy of Natural Sciences. Cope published a report on the mammals in 1889.[4]

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[1] Arch. für Naturg., 1845, I, pp. 145–149.

[2] Beiträge zur Kenntniss der Säugethiere Amerika's. Abhandl. d. math.-phys. Classe d. k.-b. Akad. d. Wissens., V. pp. 119–208, pll. ii–iv, 1847; pp. 269–332, pll. vi–viii, 1848; pp. 405–480, pl. xiv, 1848.

[3] Brasilische Säugethiere. Resultate von Johann Natterer's Reisen in den Jahren 1817 bis 1835. Verhandl. d. k.-k. z.-b. Gesells. in Wien, XXXIII, Beiheft, pp. 1–140, 1883.

[4] On the Mammalia obtained by the Naturalist Exploring Expedition to Southern Brazil. By E. D. Cope. Amer. Nat., XXIII, pp. 128–150, Feb., 1889.

Records 51 species from Chapada and 15 additional species from São João do Monte Negro. The following five forms are described as new: 1, *Myrmecophaga bivittata straminea*, p. 132; 2, *Myrmecophaga sellata*, p. 133; 3, *Tatusia megalolepis*, p. 134; 4, *Sphingurus sericeus*, p. 136; 5, *Dasyprocta aurea*, p. 138 (respecting this species see this Bull., XXXIV, p. 633, Dec. 30, 1915); 6, *Felis bracata*, p. 144.

In 1902 another collection was made at Chapada by A. Robert, in the interest of the natural history department of the British Museum, which was reported upon by Oldfield Thomas in 1903.[1] The number of specimens contained in either of these collections is not stated.

The present collection of mammals is especially important to the American Museum, it forming the first, and thus far practically the only, mammal material it has received from either Brazil or Paraguay. Its identification has therefore been extremely difficult, owing to the almost entire absence of authentically determined mammal material from this portion of South America in the museums of the United States. Under ordinary world conditions it would have been taken abroad for identification, but at the present time this was impracticable. The types of the Natterer collection are presumably still in the Vienna museum of natural history, and the collections studied by Lund, Winge and Hensel are in other European museums, while the British Museum is rich in historic mammal material relating to eastern and southern Brazil and allied faunal areas. A number of the Murids have been left undetermined, in view of the uncertainty of their identification in the absence of pertinent comparative material.

In the course of my recent work on the mammals of other parts of South America a number of supposed new forms from the Roosevelt Expedition have been described, as follows:

1. *Dasyprocta variegata urucuma*, XXXIV,[2] p. 634, Dec. 30, 1915. Urucúm.
2. *Proechimys kermiti*, XXXIV, p. 629, Dec. 30, 1915. Lower Rio Solimoens.
3. *Œcomys milleri*, XXXV, p. 523, July 24, 1916. Barão Melgaço.
4. *Oryzomys* (*Oligoryzomys*) *microtis*, XXXV, p. 525, July 24, 1916. Lower Rio Solimoens.
5. *Oryzomys* (*Oligoryzomys*) *utiaritensis*, XXXV, p. 527, July 24, 1916. Utiarity.
6. *Oryzomys* (*Oligoryzomys*) *mattogrossæ*, XXXV, p. 528, July 24, 1916. Utiarity.
7. *Zygodontomys tapirapoanus*, XXXV, p. 528, July 24, 1916. Tapirapoan.
8. *Eptesicus chapmani*, XXXIV, p. 632, Dec. 30, 1915. Lower Rio Solimoens.
9. *Molossus cherriei*, XXXV, p. 529, July 24, 1916. Tapirapoan.
10. *Cacajao roosevelti*, XXXIII, p. 651, Dec. 14, 1914. Barão Melgaço.
11. *Ateles longimembris*, XXXIII, p. 651, Dec. 14, 1914. Barão Melgaço.

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[1] On the Mammals collected by Mr. A. Robert at Chapada, Matto Grosso (Percy Sladen Expedition to Central Brazil). By Oldfield Thomas, F. R. S. Proc. Zool. Soc. London, 1903, II, pp. 232–244, pl. xxvii (*Canis sladeni*).

Thirty-seven species are recorded, the following described as new: 1, *Canis sladeni*, p. 235, pl. xxvii; 2, *Rhipidomys roberti*, p. 237; 3, *Nectomys squamipes mattensis*, p. 238; 4, *Neacomys amœnus*, p. 239; 5, *Coendu centralis*, p. 240; 6, *Sylvilagus minensis chapadæ*, p. 241; 7, *Marmosa constantiæ*, p. 243.

[2] Reference is in all cases to Bull. Amer. Mus. Nat. Hist.

This important accession to the resources of the American Museum is due to the initiative and the generosity of Theodore Roosevelt, by nature an ardent naturalist, who invited the museum authorities to send a couple of naturalists with him into Brazil to make a collecting trip for the museum, defraying their travelling and field expenses; their salaries being contributed by Cleveland H. Dodge, a trustee of the Museum. For this important work the museum selected George K. Cherrie and Leo E. Miller, both collectors and explorers of wide experience in tropical America. To Mr. Cherrie was assigned the bird work and to Mr. Miller the mammal work. Both are still in the service of the Museum, Mr. Miller, with his assistant H. S. Boyle, being at present in Argentina. He left in manuscript the field notes given in the second part of the present paper, it seeming better to segregate these notes than to insert them in the Systematic List, with which they are, however, connected by proper cross-references.

The report on the birds of the Roosevelt Expedition has been prepared by Mr. Cherrie, who has now returned for further field work along that part of the Rio Paraguay traversed by the Roosevelt Expedition, for which enterprise Mr. Roosevelt has again generously provided the means. The publication of the report on the birds is therefore postponed, so as to include the results of Mr. Cherrie's present expedition.

Systematic List.

Didelphiidæ.

1. **Didelphis marsupialis marsupialis** *Linné.*

One specimen, adult male, lower Rio Solimoens, Brazil.

2. **Didelphis paraguayensis paraguayensis** *Oken.*

Five specimens: Rio Negro, Paraguay, 2; Trinidad, Paraguay, 2; Utiarity, Matto Grosso, 1.

3. **Metachirus nudicaudatus** (*E. Geoffroy*).

One specimen, Tapirapoan, Rio Sepotuba, Matto Grosso.

4. **Metachirus opossum quica** (*Temminck*).

Didelphis quica Temminick (ex Natterer MS.) Mon. Mammal., p. 36, 1826.
D[idelphys] Quica Natt., Wagner, Schreber's Säug., Suppl., III, p. 42, 1843.

Didelphys Quica PELZELN, Verhandl. zool.-botan. Gesells. Wien, XXXIII, Beiheft, p. 110, 1883 = "*Didelphys Quica* Natt. Nr. 6" (MS.).

Metachirus Quica BURMEISTER, Erläut. Faun. Bras., p. 70, pll. vii and viii, 1856.

Five specimens, of which four are adult, and 1 a half-grown young. Urucúm, Dec. 4–10.

As stated by Thomas,[1] *Didelphis opossum* Linné, 1758, was based exclusively on Seba, for which reason he has indicated ("suggested") Surinam as the type locality of the species, a suggestion here accepted. The earliest name for the southeastern form of this widely distributed group is *Didelphis quica* Temminick, 1826, which was based primarily on specimens collected by Natterer at Sapitiba, near Rio de Janeiro, Brazil, in March, 1818. Sapitiba, Province of Rio de Janeiro, Brazil, should therefore be taken as the type locality of *quica*. The name also was a manuscript name of Natterer's adopted from him by Temminick, a fact further indicating the propriety of making Sapitiba the type locality of this form.

5. **Peramys** sp. indet.

One specimen, young in first pelage, Urucúm, Matto Grosso. Too young for satisfactory determination.

BRADYPODIDÆ.

6. **Bradypus tridactylus** *Linné.*

One specimen, adult female, lower Rio Solimoens.

MYRMECOPHAGIDÆ.

7. **Myrmecophaga tridactyla** *Linné.*

Two specimens, Las Palmieras, Rio Taquary (T. and K. Roosevelt). Both are large old males with perfect skulls.

DASYPODIDÆ.

8. **Dasypus novemcinctus** *Linné.*

One specimen, Urucúm.

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[1] Proc. Zool. Soc. London, 1911, p. 143.

9. **Priodontes giganteus** (*Desmarest*).

One specimen, Corumbá, a weathered skull, in good condition except that the teeth, the nasal bones, and the lower jaw are lacking (Cherrie).

10. **Euphractus sexcinctus gilvipes** (*Lichtenstein*).

One specimen, adult female, Urucúm.

Field measurements: Total length, 700 mm.; tail, 246; hind foot, 90. Skull, total length, 113; zygomatic breadth, 69.5. Four fully adult skulls from Chapada (sex not indicated), collected by H. H. Smith, show a wide range of individual variation, as follows: Total length, 107–123 (116.2); zygomatic breadth, 62–65 (63.2).

11. **Cabassous loricatus** (*Pelzeln,* ex Natterer MS.).

One specimen, young adult male, Utiarity, Rio Papagaio (Col. Roosevelt). Field measurements, total length 410 mm.; tail, 110, hind foot, 57.

TAYASSUIDÆ.

12. **Tayassu**[1] **pecari pecari** *Fischer.*

Three adult specimens, 1 male, 2 females, Porto Campo, Rio Sepotuba, Matto Grosso, Jan. 7, 1914 (Colonel Roosevelt).

Mr. Miller's notes give the following measurements: Length, ♂ 1140, ♀ 1050, ♀ 1090; tail, ♂ 40, ♀ 70, ♀ 60; hind foot, ♂ 90, ♀ 100, ♀ 90: ear, ♂ 70, ♀ 90, ♀ 70.

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[1] The generic names *Tayassu* and *Pecari* illustrate the absurdity of results that may sometimes arise from the strict enforcement of the rule of tautonymy in the determination of genotypes. Fischer, in founding *Tayassu,* to which he referred two species, placed *Sus tajassu* Gmelin under his species *Tayassu pecari,* which is the white-lipped peccary, thereby making the white-lipped peccary the type of the genus *Tayassu,* since this species "possessed" the tautonym *Sus tajassu.* However, *Sus tajassu* was a composite species, equal to Fischer's genus *Tayassu.* As a result the name *Tayassu,* previously restricted to the collared peccary group, became transferred to the white-lipped peccary group, in disregard of previous type determinations based on nomenclatural rules that were valid prior to the adoption of the rule of tautonymy by the International Zoölogical Congress in 1907. Furthermore, the *Sus tajacu* Linné, of earlier date than *Sus tajassu* Gmelin (a variant of the same name), is the so-called "Mexican" collared peccary, and has for generations been almost universally used for the collared peccaries, and as universally other names have been employed for the white-lipped peccaries. As a result of the application of the tautonymy principle to *Tayassu* the following confusing combinations obtain in the specific names of the peccary group, now commonly recognized as comprising two genera: *Tayassu pecari* and *Pecari tajacu!*

13. **Pecari tajacu**[1] (*Linné*).

Four specimens, all adult, 3 males, 1 female: Urucúm, 1 (Miller); Porto Campo, Rancho Palmiras, São Lourenço, 1 each (Roosevelt). There is also a young pig, in first pelage (yellowish rufous, with a broad black dorsal band), too young for positive identification as to the species, from Calama, Rio Madeira, Amazonas (Miller).

Mr. Miller's measurements of the three males from Matto Grosso: Total length, 920, 920, 920; tail, 30, —, 30; hind foot, 80, 80, 80.

CERVIDÆ.

14. **Hippocamelus bisulcus** (*Molina*).

A flat skin, without data, but doubtless from Patagonia.

15. **Blastocerus dichotomus** (*Illiger*).

Cervus dichotomus ILLIGER, Abhand. d. k. Akad. zu Berlin, 1811 (1815), p. 108 (nom. nud.), p. 117 = *Gouazoupoucou* Azara.

Cervus paludosus DESMAREST, Mamm., II, 1822, p. 443 = *Gouazoupoucou* Azara.

Two specimens, adult male and female, Palmira, Matto Grosso, Dec. 17 (K. Roosevelt).

16. **Blastocerus bezoarticus**[2] **campestris** (*F. Cuvier*).

Two specimens, adult and semi-adult males, Tapirapoan, Jan. 23 (K. Roosevelt).

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[1] The type locality of *Sus tajacu* Linné was fixed by Cope in 1889 (Amer. Nat., XXIII, p. 141), when he retained this name for the Paraguay animal in describing a new species of peccary from Texas. (*Cf.* Hollister, Proc. Biol. Soc. Washington, XXVIII, p. 70, March 12, 1915). In 1902, I also considered Paraguay as the type locality of both *Sus tajacu* Linné and of *Sus albirostris* Illiger (= *labiatus* Cuvier). As stated by Hollister, Linné's citation of Tyson is inadequate for the determination of the type locality of *Sus tajacu*, as Tyson makes no reference to the geographical origin of the specimen he dissected beyond calling it "*Aper Mexicanus Moschiferus* or Mexican Musk Hog."

[2] Lydekker (Deer of all Lands, 1898, p. 289) and Thomas (Proc. Zool. Soc. London, 1911, p. 151) believe that *Cervus bezoarticus* Linné (Syst. Nat., 1758, p. 67 = *Cervus cuguapara* Kerr, 1792) should be adopted for the pampas deer of Brazil, this name having been based on the Cuguacu-apara of Marcgrave (type locality, Pernambuco). Until, however, the deer of this group are better known it seems well to employ the name *campestris*, based on the Gouazoute of Azara, as a subspecific designation for the southern form, which can hardly be the same as the pampas deer of the Pernambuco district.

17. **Mazama rufa rufa** (*Illiger*).

Seven specimens: Urucúm, 3 specimens (Miller and Cherrie); Porto Campo, 4 specimens (T. and K. Roosevelt). (*Cf.* this Bull., XXXIV, p. 538, 1915.)

18. **Mazama simplicicornis** (*Illiger*).

One specimen, Rio Negro (near Asuncion), Paraguay (Miller). (*Cf.* this Bull., XXXIV, p. 547, 1915.)

TAPIRIDÆ.

19. **Tapirus terrestris** (*Linné*).

Three adult specimens, skins and skulls, Porto Campo, Rio Sepotuba, Matto Grosso, Jan. 10, 1914 (Roosevelt).

Mr. Miller's measurements of a male and female: Total length, ♂ 2070, ♀ 2000 mm.; tail, ♂ 60, ♀ 100; hind foot, ♂ 140, ♀ 140; ear, ♂ 120, ♀ 120. The skulls of the two males have the braincase badly shattered; the female skull, very old and with the teeth greatly worn, has the total length, 360; condylobasal length, 348; zygomatic breadth, 163; interorbital breadth, 74; postorbital breadth, 58; mastoid breadth, 103; breadth of rostrum at canines, 49; palatal breadth at p^2, 34.5, at m^3, 49; maxillary toothrow, 122; m^1–m^3, 58.5; length of lower jaw, 293; height at condyle, 125.5; height at coronoid process, 152.5; lower toothrow, 112.

A large perfect young adult skull (probably male) from British Guiana (L. E. Miller) is much larger than either of the male skulls from Matto Grosso. Its measurements are, total length, 415; condylobasal length, 390; zygomatic breadth, 195; interorbital breadth, 93 (84.5 in Matto Grosso male skull of comparable age); postorbital breadth, 70.3 (64 in M. G. ♂); mastoid breadth, 121.5; diastema, 45 (51 in M. G. ♂); maxillary toothrow, 145.5 (126.5 in M. G. ♂); m^1–m^3, 70 (61 in M. G. ♂); lower jaw length, 345 (305 in M. G. ♂); height at condyle, 133.5 (113 in M. G. ♂); height at coronoid, 177 (146 in M. G. ♂); lower toothrow, 137 (117 in M. G. ♂); m_1–m_{31} 51.5.

The contrast in massiveness between the Guiana skull and the three from Matto Grosso is striking but there is very little difference in details of structure. The great difference in size, however, seems nomenclaturally noteworthy, and mainly on this basis the Guiana form may be designated as **Tapirus terrestris guianiæ**, with No. 36198 (skull only) Tumatumari, British Guiana, collected by Leo E. Miller, as type. As the type locality of *Tapirus terrestris* is Pernambuco (*cf.* Thomas, P. Z. S., 1911, p. 155), it is probable that both the Matto Grosso and Guiana forms will prove subspecifically separable from true *terrestris*.

LEPORIDÆ.

20. **Sylvilagus paraguensis** *Thomas.*

Two specimens, Paraguay: Trinidad, near Asuncion, adult female; Rio Negro, up the Pilcomayo from Asuncion, young adult male.

VISCACCIIDÆ.

21. **Viscaccia cuscus** *Thomas.*

Two flat skins, without head, limbs or tail, purchased of a furrier at Buenos Aires, are provisionally referred to this form. Locality of capture unknown.

CAVIIDÆ.

22. **Cavia (Cavia) rufescens pamparum** *Thomas.*

Three specimens (young adult male, adult female, young female in first pelage), Rio Negro, Paraguay, about 100 miles north of Asuncion.

External measurements (young male and adult female): Total length, ♂ 280, ♀ 330 mm.; tail, 15, 15; hind foot 40, 45. Skull (same specimens), total length, ♂ 64, ♀ 63; zygomatic breadth, 34.5, 36. These measurements slightly exceed those of the type, from Corrientes, as given by Thomas.

23. **Cavia (Galea) boliviensis** (subsp. indet.).

One specimen, Tapirapoan, Rio Sepotuba (Cherrie).

24. **Dolichotis salinicola** *Burmeister.*

Two flat skins, without limbs, purchased of a furrier at Buenos Aires. Locality of capture unknown.

HYDROCHŒRIDÆ.

25. **Hydrochœris hydrochœris** (*Linné*).

Three specimens: Palmiras, 1 (adult female); San Juan, 1 (adult male); São Lourenço, 1 (young female), December, 1913 (Roosevelt).

Measurements of adult male: Total length, 1220 mm.; tail, 40; hind foot, 240; ear, 50. Skull, total length, ♂ 226, ♀ 214; occipitonasal length, ♂ 210, ♀ 212; condylobasal length, ♂ 215, ♀ 200; zygomatic breadth, ♂ 128, ♀ 125; length of nasals on midline, ♂ 79, ♀ 80; maxillary toothrow, ♂ 87, ♀ 74.5; diastema, ♂ 68, ♀ 66.

The three specimens vary greatly in color, the male being purplish red brown, the old female pale yellowish brown, and the young female intermediate between the other two, or dull ruddy yellowish brown.

26. **Dasyprocta agouti leptura** *Wagner.*

One young specimen, lower Rio Solimoens.

This specimen differs from Guiana specimens of *D. agouti agouti*, and from a specimen of corresponding age from Pará, in being much darker, the whole back being much blacker, and the sides and belly dark chestnut red.

27. **Dasyprocta croconota croconota** *Wagler.*

Two specimens, Calama, lower Rio Madeira. (*Cf.* this Bulletin, XXXV, p. 628, Dec. 30, 1915.)

28. **Dasyprocta fuliginosa fuliginosa** *Wagler.*

Five specimens, Calama (near Borba), lower Rio Madeira, hence practically topotypes of *D. fuliginosa* Wagler. (*Cf.* this Bulletin, XXXIV, p. 626, Dec. 30, 1915.)

29. **Dasyprocta variegata urucuma** *Allen.*

One specimen, Urucúm (near Corumbá), Matto Grosso. (*Cf.* this Bulletin, XXXIV, p. 634, Dec. 30, 1915.)

30. **Dasyprocta azaræ** *Lichtenstein.*

Two specimens, Tapirapoan and Utiarity, Matto Grosso.

31. **Dasyprocta (Myoprocta) exilis exilis** *Wagler.*

Dasyprocta exilis Wagler, Isis, 1831, p. 621. "Brasilia ad flumen Amazonum."

Dasyprocta pratti Pocock, Ann. and Mag. Nat. Hist. (8), VII, p. 110, July, 1913. Type said to have been brought "from the Amazons."

One specimen, Calama, Lower Rio Madeira.

Dasyprocta exilis Wagler has usually been synonymized as a young specimen of *D. acouchy*. The type was obtained by Spix on the Rio Amazon, presumably near the mouth of the Rio Negro, which it seems proper to designate as the type locality of *D. exilis*. It had no tail,[1] but this slender appendage in the *Myoprocta* group easily becomes detached in dry skins.

D. exilis belongs evidently to the olivaceous and not to the rufous section of the genus. Pocock's *Myoprocta pratti* agrees well with Wagler's description of *exilis* and with my Calama specimen. The type locality is as indefinite as the type locality of *exilis*. It seems perfectly safe to assume that both came from that portion of the Amazon drainage which includes the lower Rio Negro and the lower Rio Madeira.

OCTODONTIDÆ.

32. **Ctenomys nattereri** *Wagner.*

One specimen, José Bonefascio, Matto Grosso.

Total length, 290 mm.; head and body, 218; tail, 72; hind foot, 46.

33. **Proechimys longicaudatus** (*Rengger*).

Five specimens: Urucúm, 2; Utiarity, 1; Tapirapoan, 2.

An old male from Utiarity measures, total length, 450 mm.; head and body, 250; tail, 200; hind foot, 55. This is the largest and much the oldest of the series.

34. **Proechimys kermiti** *Allen.*

One specimen, lower Rio Solimoens. (*Cf.* this Bull., XXXIV, p. 629, Dec. 30, 1915.)

MURIDÆ.

35. **Epimys rattus rattus** (*Linné*).

One specimen, Calama.

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[1] Wagler says: "Caudam non observo."

36. **Epimys rattus alexandrinus** (*Geoffroy*).

Eight specimens, Urucúm, 6; Calama, 2.

37. **Epimys norvegicus** (*Erxleben*).

Two specimens, Trinidad (near Asuncion), Paraguay.

38. **Neacomys spinosus amœnus** *Thomas*.

Two specimens: Barão Melgaço, 1; Utiarity, 1.

39. **Rhipidomys** sp. indet.

One specimen, Barão Melgaço. In bad condition, lacking ears and tail, and the skull lacks the palatal region.

40. **Œcomys milleri** *Allen*.

Six specimens: Barão Melgaço, 5; Urupa, 1. (*Cf.* this Bull., XXXV, p. 523, July 24, 1916.)

41. **Oryzomys laticeps** (*Lund*).

One specimen, Maracana.

42. **Oryzomys angouya** (*Desmarest*).

One specimen, Trinidad, Paraguay.

43. **Oryzomys** sp. indet.

One specimen (in bad condition), Rio da Dúvida (Rio Roosevelt).

44. **Oryzomys** sp. indet.

Seven specimens: Tapirapoan, 3; São João, 4.

These specimens have the same character of pelage and somewhat similar coloration as *Oryzomys laticeps* but are about one half smaller. They apparently include two species, one specimen being quite different from the others.

45. **Oryzomys** sp. indet.

One specimen, Tapirapoan, an adult female without tail. Belongs to the *O. xantheolus* group.

46. **Oryzomys (Oligoryzomys) microtus** *Allen.*

Nine specimens, lower Rio Solimoens. (*Cf.* this Bull., XXXV, p. 525, July 24, 1916).

47. **Oryzomys (Oligoryzomys) utiaritensis** *Allen.*

Two specimens, Rio Papagaio. (*Cf.* this Bull., XXXV, p. 527, July 24, 1916.)

48. **Oryzomys (Oligoryzomys) mattogrossæ** *Allen.*

Two specimens: Utiarity, 1; Guatsué, 1. (*Cf.* this Bull., XXXV, p. 528, July 24, 1916.)

49. **Zygodontomys tapirapoanus** *Allen.*

Thirty-four specimens: Tapirapoan, 11; Utiarity, 16; Urucúm, 2; Tres Burity, 2; São João, 2; Volhena, 1. (*Cf.* this Bull., XXXV, p. 528, July 24, 1916.)

50. **Holochilus amazonicus** *Osgood.*

Six adult specimens, 3 males, 3 females, lower Rio Solimoens.

Collector's measurements: Total length, 3 males, 371 (370–373) mm., 3 females, 361 (345–370); head and body, 3 males, 195 (185–203), 3 females, 196 (190–202); tail, 3 males, 176 (170–185), 3 females, 165 (155–172); hind foot, 3 males, 42.7 (40–45), 3 females, 41.3 (40–42).

51. **Holochilus vulpinus** (*Brants*).

One specimen, adult male, Urucúm. Total length, 340 mm.; head and body, 170; tail, 170; hind foot, 40.

52. **Nectomys squamipes** (*Brants*), subsp.

One specimen, Urupá, Rio Gy-Paraná.

An adult female (without skull), referable to the *N. squamipes* group.

53. **Oxymycterus rufus** (*Desmarest*).

One specimen, immature, Campos Novos.

SCIURIDÆ.

54. **Urosciurus langsdorffi urucumus** (*Allen*).

Sciurus langsdorffii urucumus ALLEN, Bull. Amer. Mus. Nat. Hist., XXXIII p. 595, Sept. 8, 1914.

Urosciurus langsdorffii urucumus Allen, ibid., XXIV, p. 278, May 17, 1915.

Eleven specimens: Urucúm, 8; Tapiropoan, 3.

55. **Urosciurus pyrrhonotus pyrrhonotus** (*Wagner*).

One specimen, Calama, practically a topotype. (*Cf.* this Bull, XXXIV, p. 275, 1915.)

MUSTELIDÆ.

56. **Tayra barbara gulina** (*Schinz*).

Two specimens: an old female, skin with skull, Rio Negro, Paraguay; a flat skin without skull, Curumbá, Matto Grosso.

Collector's measurements of the Rio Negro specimen: Total length, 1040 mm.; head and body, 610; tail vertebræ, 430; hind foot, 100. The skull measures, total length, 110; condylobasal length, 109.3; zygomatic breadth, 70; interorbital breadth, 26; postorbital breadth, 24; breadth of braincase, 45.2; mastoid breadth, 51.7; length of maxillary toothrow, outer border, 19.3.

Mustela gulina Schinz was based on specimens in Wied's collection, and the name was obviously from Wied, as the latter says (Beitr. Naturg. Bras., II, 1826, p. 310): "Dieses Thier habe ich früher mit dem Namen *Mustela gulina* belegt, ..." The only locality definitely mentioned for the species is (*l. c.*, p. 318) Morro d'Arara, on the northern border of Espiritu Santo, Brazil, which may be taken as the type locality.

The head and nape in the present specimens are grayish dark brown, passing on the middle of the back insensibly into the darker blackish brown of the posterior third of the body. The skull is heavy, and relatively broad and short in comparison with some of the western and northern forms of the *barbara* group.

57. **Grison furax** *Thomas.*

One specimen, a flat skin without skull, Curumbá, Matto Grosso.

58. **Conepatus suffocans** (*Illiger*).

A flat skin, from "Terra del Fuego." Another flat skin from Chubut is apparently referable to this species, though not typical.

59. **Conepatus feuillei** (*Eydoux and Souleyet*).

Conepatus mapurito monzoni Aplin, Proc. Zool. Soc. London, 1894, p. 302, Soriano, Uruguay.

A flat skin, Paraná, Entre Rios, Argentina.

60. **Conepatus proteus** *Thomas.*

A flat skin from Cordova, Argentina.

PROCYONIDÆ.

61. **Procyon (Euprocyon) cancrivorus nigripes** (*Mivart*).

Black-footed Raccoon, Sclater, Proc. Zool. Soc. London, 1875, p. 421, "probably S. E. Brazil and Paraguay."

Procyon nigripes Mivart, *ibid.*, 1885, p. 347. = *Black-footed Raccoon* of Sclater, as above. Paraguay may be assumed as the type locality.

Procyon cancrivorus brasiliensis Ihering, Arch. für Naturg., 1910, Heft 2, p. 167, Oct., 1910; Revis. Mus. Paulista, VIII, p. 228, Sept., 1910. (*Cf.* Hollister, Biol. Soc. Washington, XXVII, p. 215, Oct. 31, 1914.

Two specimens, flat skins, from Province of Corrientes, Argentina.

62. **Nasua nasua solitaria** *Schinz* (ex Wied, MS.).

Six specimens: Urucúm, 5 (2 males, 3 females, all adult); São Lourenço, 1, (adult male). Four are in the so-called 'gray' phase and two are in the 'red' phase. The two red specimens are both from Urucúm, and are, respectively, male and female.

The four specimens in the 'gray' phase are remarkably uniform in coloration; the prevailing color of the upperparts is blackish, the hairs being subapically pale yellowish gray with long black tips, which dominate the coloration. The two specimens in the red (erythrysmal) phase also agree in coloration, the upperparts being yellowish red, the dark tail-rings red and the alternating light rings yellowish white.

It is quite probable, on both faunal and geographic grounds, that the southern Matto Grosso animal is subspecifically separable from true *solitaria* of the southeast coast region of Brazil; lack of material in the present connection, however, renders impossible direct comparison of the coatis of these two regions.

The earliest identifiable names for the *Nasua* of southeastern Brazil are *Nasua solitaria* and *N. sociabilis* Schinz [1] (ex Wied MS.), 1821, which are the same, respectively, as *Nasua solitaria* and *N. socialis* Wied, 1826,[2] *N. solitaria* being based on old males and *N. socialis* on females and young males, as stated by Wied, who regarded his *N. solitaria* as very doubtfully distinct from his *N. socialis*. Unfortunately, through Schinz's prior publication of these names, both have the same standing, except that *solitaria* has page precedence over *sociabilis* (= *socialis* Wied), and therefore requires acceptance.

63. **Potos flavus** (subsp.?)

Three pelts without feet, purchased at a furrier's in Buenos Aires; not satisfactorily identifiable.

CANIDÆ.

64. **Chrysocyon jubatus** (*Desmarest*).

Two specimens: Urucúm, adult male, skin and skull, Dec. 9, 1913; Curumbá, hunter's pelt, imperfect.

65. **Cerdocyon thous azaræ** (*Wied*).

Five specimens (skins with skulls), 2 males, 3 females, all adult, Trinidad (near Asuncion), Paraguay.

Collector's measurements, total length, 966 (940–1010) mm.; head and body, 708 (680–740); tail vertebræ, 258 (240–270); hind foot, 132 (120–140). The largest of the series is a female.

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[1] Thierreich, I, 1821, p. 199.

[2] Beitr. zur. Naturg. von Brasilien, II, 1826, pp. 292 and 283.

66. **Lycalopex vetulus** (*Lund*).

Two imperfect skins, without skulls, are provisionally referred to this species. One is labeled "North Patagonia," the other "Brazil," the latter being probably from Matto Grosso.

67. **Panthera**[1] **paraguensis** (*Hollister*).

Felis paraguensis Hollister, Proc. U. S. Nat. Mus., LVIII, No. 2069, p. 169, Dec. 16, 1914 ("Collected in Paraguay." Not *Panthera paragayensis* Oken, 1816, a species of ocelot.

Seven skins and 6 skulls (2 old males, 3 adult females, 2 kittens a few months old), all from the immediate vicinity of Curumbá, Matto Grosso. One of the specimens, an old male, was killed by Colonel Roosevelt, and the others were received from Mr. J. G. Ramsay through the Roosevelt Expedition. All the skulls and four of the skins are in the Museum collection of mammals; two of the skins were only loaned for examination.

The skins vary greatly in coloration; in all the dark markings are very heavy, greatly restricting the area of the ground color. The markings vary with each specimen. There is a tendency to a triple row of black spots along the midline of the back, the middle row of spots being solid black and the outer rows with open centers; in one specimen the spots of all three rows are nearly solid black; in other specimens there is a broad central area of tawny, with one to three small dots of black. In one specimen the median line of heavy elongate black spots is divided into two narrow lines of solid black spots for the posterior half of the dorsal line. The ground color, except on the ventral surface, where it is white, is deep golden tawny, but the depth of tone varies greatly in different specimens.

Three of the adult skins (soft tanned) measure as follows: Total length, ♂ 2500 mm.; ♀ 2200, ♀ 2185; length of tail (excluding the hair at the tip), ♂ 825; ♀ 580, ♀ 540; tip to tip of outstretched fore limbs, ♂ 1740, ♀ 1480, ♀ 1450. These measurements greatly exceed those of comparable specimens from Amazonas, Venezuela, and Central America.

Five adult skulls (2 males, 3 females, all from Curumbá) measure as follows, in comparison with the type (male) skull of *paraguensis:*

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[1] *Panthera* Oken, Lehrbuch der Naturgeschichte, Th. 3, Abth, 2. 1816, p. 1052. Type, by tautonymy, *Panthera vulgaris* Oken, = *Felis pardus* Linné = *Felis panthera* Pallas.

Jaguarius (subgenus of *Panthera*) Severtzow, Rev. et Mag. de Zool., Sér. 2, X, pp. 386, 390, Sept., 1858. Type, by monotypy, *Felis onca* Linné.

	37503 ♂	36950 ♂	37550 ♀	37549 ♀	36949 ♀	4128N[1] ♂
Total length	305	300	262	255	240	303
Condylobasal length	280	260	241	232	219	265
Zygomatic breadth	208	196	170	166	163	196
Nasals (on median line)	74	65	60	65	59	63
Audital bullæ, length	47.5	48	49	41	40	40.5
" " breadth	33	34	31	27	30	37
Carnassial, length	28	28	27	28.2	27	28.8
" breadth	15.1	14	15	15	15	15.2
Length of p^2 and p^3	48	46.5	46.6	46.5	45	48.3

The two old male skulls agree very closely in measurements with the type (No. 4128, U. S. Nat. Mus., old ♂) of *Felis paraguensis* Hollister, which, through Mr. Hollister's kindness, is before now me, rendering possible its direct comparison with the Curumbá material. The female skulls from Curumbá are naturally much smaller than the males, and two of them are also somewhat younger. The type locality of *paraguensis* is given as "collected in Paraguay by Capt. T. J. Page, United States Navy." It does not differ in any essential particular from the male skulls from Curumbá. This type skull was studied by me, with other jaguar material, in 1906 (*cf.* Bull. Amer. Mus. Nat. Hist., XXII, pp. 214–218), when the large size of the jaguars of southern Brazil, in comparison with those of Central America, Venezuela, and Amazonas, was noted, but the material at hand seemed insufficient to serve as the basis for a revision of the group. The present Curumbá material confirms the conclusions then reached and shows conclusively the occurrence of a very large form of jaguar in southern Brazil and Paraguay.

My material, however, does not indicate that distinctions based on the size and shape of the audital bulla and surrounding parts afford very

Description of Figures 1–6 (p. 577).

Fig. 1. *Panthera paraguensis* Hollister. Type, No. 4128, U. S. Nat. Mus. Adult male, Paraguay. ½.

Fig. 2. *Panthera paraguensis*, No. 37503, Amer. Mus. Adult male, Curumbá, Matto Grosso, Brazil. ½.

Fig. 3. *Panthera paraguensis*. No. 36950, Amer. Mus. Adult male, Curumbá, Matto Grosso, Brazil. ½.

Fig. 4. *Panthera paraguensis*. No. 36949, Amer. Mus. Adult female, Curumbá, Matto Grosso, Brazil. ½.

Fig. 5. *Panthera paraguensis*. No. 37550, Amer. Mus. Adult female, Curumbá, Matto Grosso, Brazil. ½.

Fig. 6. *Panthera paraguensis*. No. 37549, Amer. Mus. Adult female, Curumbá, Matto Grosso, Brazil. ½.

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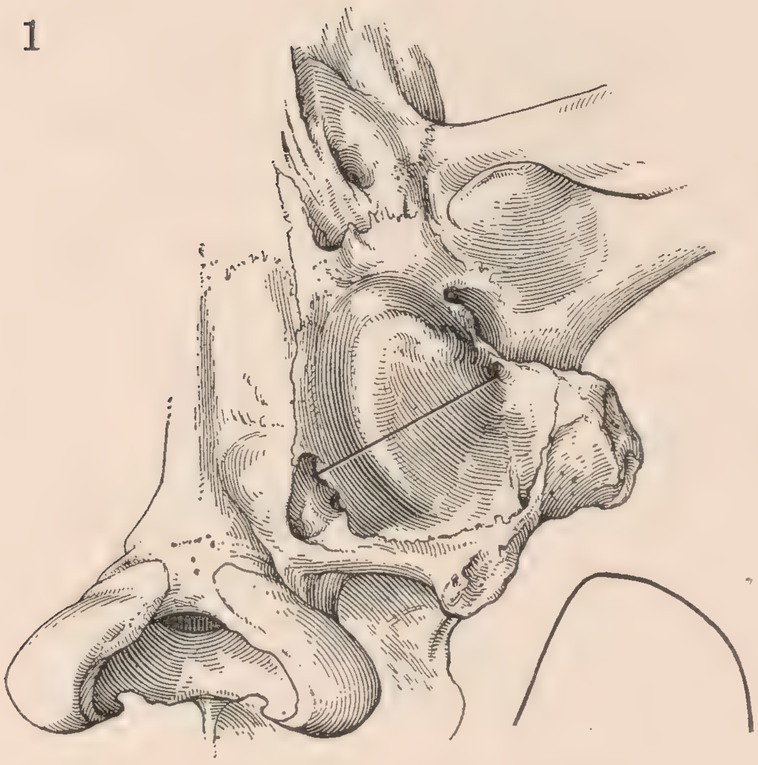
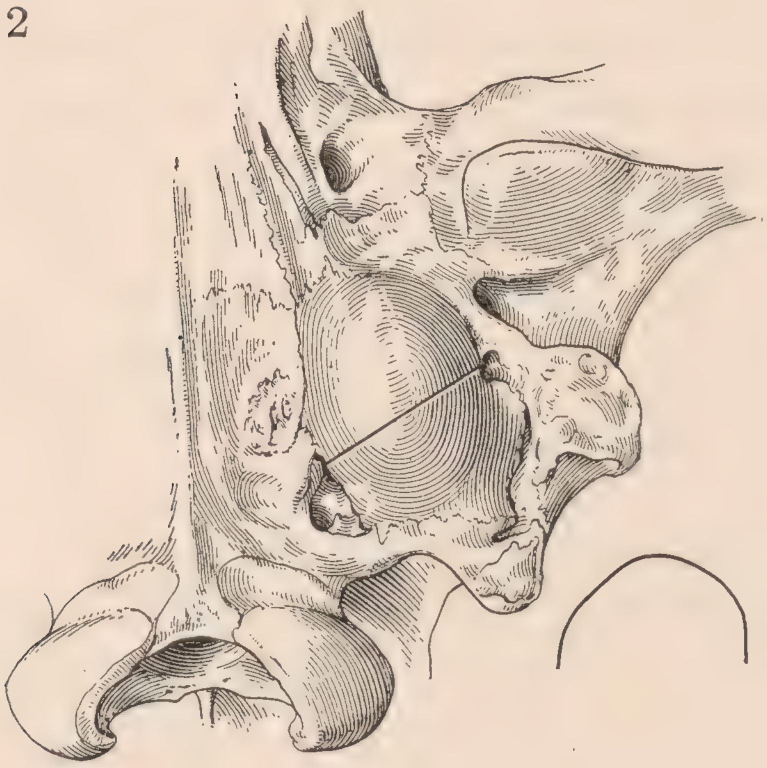
[1] Type of *Felis paraguensis* Hollister.

1



2



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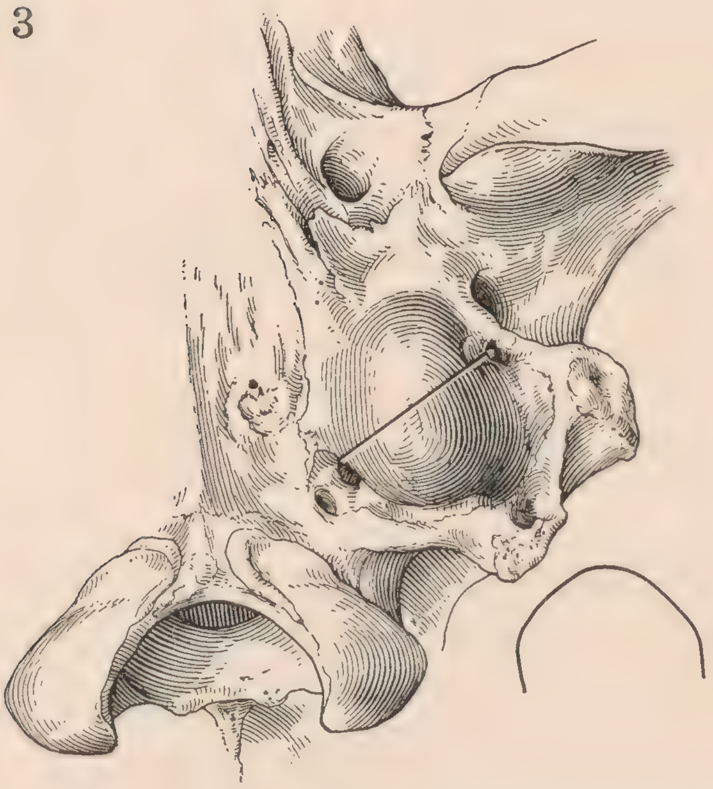

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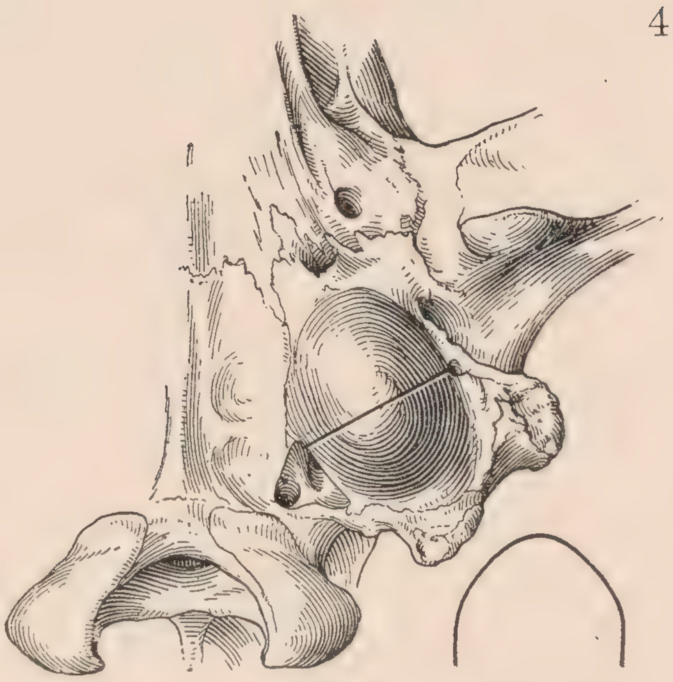

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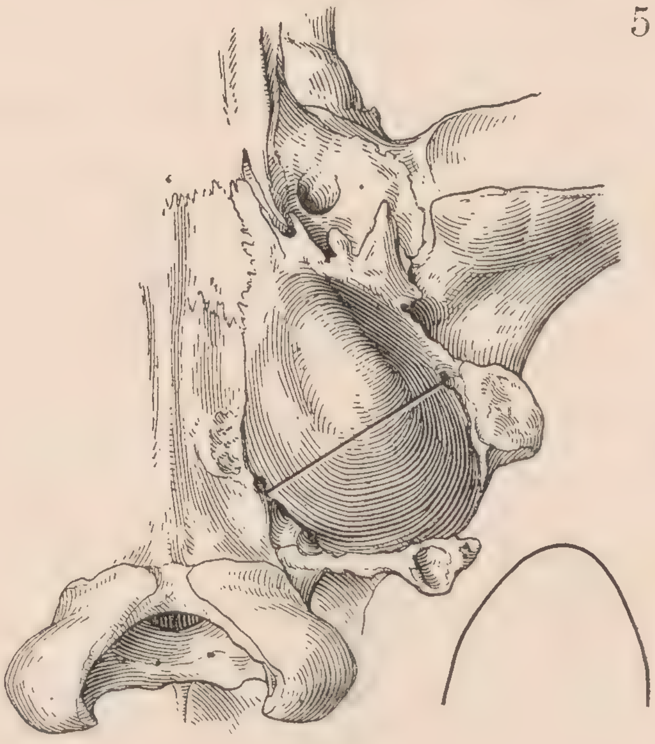

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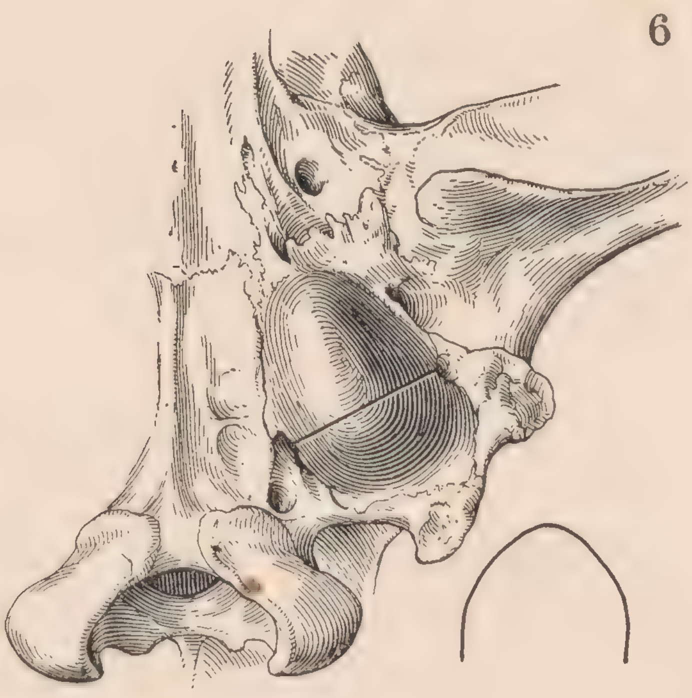

(For description of Figures see opposite page.)

trustworthy characters. The bullæ in my series present a wide range of variation, being sometimes quite unlike on the two sides of the same skull. The extremes in this respect are presented by No. 37503, ♂ ad., and No. 36950, ♂ ad. In No. 37503 the left bulla (the right one is lacking) is small, evenly elliptical in outline, evenly convex, with the highest part of the convexity mesial; in No. 36950 the bullæ are much broader, expanded posteriorly and narrowed anteriorly, with the highest point of the convex surface nearer the inner border. The bullæ in this specimen agree quite closely with the bullæ of the type skull of *paraguensis*, except that in the latter the front portion is more swollen and ends more abruptly. The left bulla of the type of *paraguensis* and of five adult skulls from Curumbá are shown in the accompanying illustrations (Figs. 1–6) and well illustrate the variability of this feature in jaguars referable to *paraguensis*. The difference in transverse contour is shown diagrammatically by cross-sections.

The range of *Panthera paraguensis* is at present very imperfectly known, but it evidently includes Paraguay and southwestern Brazil. Two skins (without skulls) from Paraná, recently presented to the American Museum by Miss Eliza Kuhl Hughes, seem referable to this form, but they differ from the Curumbá skins in the much paler tone of the ground color and the smaller areal extent of the black markings, which are narrower and less heavily developed. A female skull from Chapada, Matto Grosso, collected by H. H. Smith, in January, 1885, agrees, as would be expected, in size and in all essential features with old skulls of females from Curumbá.

The name *Panthera paraguensis* is here adopted provisionally, in view of the earlier *Panthera paragayensis* Oken (1816), given to an ocelot. Oken in his 'Lehrbuch der Naturgeschichte' (dritter Theil, zweite Abtheilung) consistently employed "Paragay" for Paraguay, and in using it as the basis of specific names added the suffix *-ensis,* giving the form *paragayensis*, instead of taking "Paraguay" for the stem. The opinions of authorities at present appear to differ as to whether *paragayensis* (Oken's name in full is [*Felis*] *Panthera paragayensis, Panthera* being merely a section of his genus *Felis*) will render untenable a later *Felis paraguensis*. Both names are etymologically identical.

68. **Panthera onca** (*Linné*).

The Roosevelt collection contains a tanned skin of a black jaguar and two skulls without skins, from at present unknown localities. The skulls are strictly of the *onca* type, and are, respectively, male and female. The principal measurements of the skulls are as follows: greatest length, No. 36240, ♂ ad., 225 mm., No. 36241, ♀ ad., 206; condylobasal length, ♂ 201,

♀ 188; zygomatic breadth, ♂ 150, ♀ 139; nasals (on median line), ♂ 54, ♀ 47; audital bullæ, ♂ 39 × 25, ♀ 31 × 19; carnassial (length), ♂ 22.5, ♀ 23.5; length of p^2 and p^3, ♂ 38, ♀ 39. (The teeth are larger in the female than in the male.)

The melanistic skin is black with a slight brownish cast, of an apparently uniform tone, but on close examination the usual deep black markings can be recognized.

Two hunter's pelts of kittens, without exact locality, are also provisionally referred to *onca.*

69. **Puma puma concolor** (*Linné*).

Skin with skull (No. 37505, ♀ ad.), from Curumbá, Matto Grosso, received from J. G. Ramsay (through the Roosevelt Expedition). Also a skull (No. 36242) from an at present unknown locality.

The skin has a broad median dorsal band of dull red, extending from the crown to near the end of the tail, in strong contrast with the paler color of the sides of the body; inside of the limbs white; ventral surface pale buff; tip of tail dull black for the terminal 60 mm., preceded by a half ring of dull white on the dorsal side.

The two skulls agree in size and in all other features, and both are probably females. Yet it is evident that they represent a small form of the puma group, doubtless referable to *P. p. concolor.* The principal measurements of these skulls are: No. 37505, ♀ ad., greatest length, 186, No. 36242, ♀ ad., 184.5 mm.; condylobasal length, 167, 165; zygomatic breadth, 123.5, 123.5; nasals (on median line), 44, 43; audital bullæ, 33 × 20, 32 × 17; upper carnassial, 21.6 × 12, 21 × 11; length of p^2 and p^3, 36.3, 35.3.

70. **Puma pearsoni** (*Thomas*).

A tanned skin of an old female, in excellent condition but without skull, from "Patagonia," represents the gray phase of *pearsoni.*

71. **Herpailurus**[1] **jaguarundi jaguarundi** (*Fischer*).

One specimen, a tanned skin without skull, in the dark or 'yaguarundi' phase, vicinity of Curumbá.

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[1] *Herpailurus* Severtzow, Rev. et Mag. Zool. (2), X, 1858, pp. 385, 390. Species, "*Felis yaguarundi* Azara" and "*F. eyra* Azara."

72. **Lynchailurus pajeros pajeros** (*Desmarest*).

An imperfect hunter's pelt, without skull, from the pampas of central Argentina.

73. **Oncoides pardalis chibigouazou** (*Griffith*).

Felis chibigouazou GRIFFITH, Animal Kingdom, II, 1827, p. 167, No. 431.—MEARNS (ex Griffith), Proc. U. S. Nat. Mus., XXI, No. 1286, p. 246, Sept. 17, 1902. Redescribed from specimens from Chapada, Matto Grosso, Brazil.

Six pelts, without skulls, from Curumbá, presented to the Roosevelt Expedition by the Brazilian Land, Cattle and Packing Company of Curumbá, through the superintendent, Mr. J. G. Ramsay.

Felis chibigouazou of Griffith is here taken as restricted by Dr. Edgar A. Mearns in his important paper on the Ocelots published in 1902.[1] His description is based on a specimen from Chapada, Matto Grosso, not far from where the present series was collected, and near the region (Paraguay) of Azara's Chibigouazou. Mearns's description applies satisfactorily to the specimens here in hand.

74. **Margay[2] tigrina[3] wiedi** (*Schinz*).

One specimen (No. 36980, ♂ ad.), Urucúm, Nov. 30, 1913, skin and skull in fine condition.

Collector's measurements: Total length, 950 mm.; head and body, 560; tail vertebræ, 390; hind foot, 130.

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[1] The Ocelot Cats. By Edgar A. Mearns, Major and Surgeon, U. S. A., Proc. U. S. Nat. Mus., XXI, No. 1286, pp. 237–249, Sept. 17, 1902. *Felis chibigouazou*, p. 246.

[2] *Margay* GRAY, Proc. Zool. Soc. London, 1867, p. 271 (subgenus of *Felis;* species, *Felis macroura* Wied, *F. mitis* F. Cuvier, *F. tigrina* Schreber. *Felis macroura* Wied (= *Felis wiedi* Schinz) is here designated as the type. The group will also include *Felis geoffroyi* D'Orbigny, *Felis guttula* Hensel, *F. glaucula* Thomas.

[3] *Felis tigrina* SCHREBER, Säug., Th. III, pl. cvi, 1775 (*fide* Sherborn, P. Z. S., 1891, p. 588); *Die Maraguay*, in text, p. 396, 1777. Based on *Le Margay* of Buffon, Hist. Nat., XIII, 1765, pp. 248–253, pl. xxxvii, described and figured from a specimen taken in Cayenne.— (*Cf.* Thomas, Ann. and Mag. Nat. Hist. (7), XII, p. 235, footnote, August, 1903.)

Felis tigrina ERXLEBEN, Syst. Reg. Anim., 1777, p. 517. — Erxleben cites Schreber's work, the text as well as the plate. The name *Felis tigrina* Schreber has two years priority over *Felis tigrina* Erxleben.

Felis wiedi SCHINZ, Thierreich, I, 1821, p. 235. Based on specimens in the Wied Coll.

Felis macroura WIED, Beiträge zur Naturg. Brasilien, II, 1826, pp. 371–379; Abild., Lief. 3 (plate and text not numbered). Type locality, northern Espirito Santo, Brazil. No definite type locality is mentioned by the author, but he says: "In den grossen Urwäldern zu Morro d'Arara am Mucuri erhielt ich auf diese Art in Zeit von vierzehn Tagen drei solche Katzen; eine vierte shoss einer meiner Jäger am Espirito Santo von eineim hohen Baume herab, ..." As the Rio Mucury forms the northern boundary line of Espirito Santo, it seems desirable to designate northern Espirito Santo as the type locality of *Felis macroura* Wied (= *Felis wiedi* Schinz of earlier date), and therefore of *F. wiedi*.

Skull, total length, 94; condylobasal length, 88; zygomatic breadth, 64.7; greatest length of nasals, 23.5; postorbital breadth, 34; interorbital breadth, 17; breadth of braincase, 43.3; mastoid breadth, 44; maxillary toothrow, 20; carnassial, 11 × 5. Although the skull is very old and the muscular scars are strong, there is no tendency whatever to a sagittal crest. The orbit is nearly closed behind; the postorbital and malar processes meet but are not fused.

75. **Margay guttula** (*Hensel*).

One specimen (No. 36948), without skull, São Lourenço, collected by Kermit Roosevelt.

This specimen is very dark, both above and below, with a dark yellowish ground color, nearly as deep on the ventral surface as above, the black markings profuse on the ventral surface. Black rings on the tail quite distinct for the whole length.

Another specimen (No. 36225) from "Paraná," a flat skin without skull or definite locality, presented by Miss Eliza Kuhl Hughes, is similar in markings, including the broad complete black rings on the tail, but the ground color is much lighter.[1]

Felis pardinoides Gray, Proc. Zool. Soc. London, 1867, p. 400. "*Hab.* India (*Capt. Innes;* from Zool. Soc. Mus.)"; Cat. Carn. Pachy. and Edent. Mamm., 1869, p. 27 (same as above). Referred to *Felis geoffroyi* by Elliot (P. Z. S., 1872, p. 203).

"*Felis pardinoides* Gray" Thomas, Ann. and Mag. Nat. Hist. (7), XII, pp. 236, 237, Aug, 1903, "'. . . description of two fresh specimens [from Espiritu Santo, Brazil, collected by A. Robert] apparently assignable to the little-known *F. pardinoides*, Gray."

? *Felis mitis* F. Cuvier, Hist. nat. Mamm., livr. XVIII (plate and four pages of text), July, 1820; *ibid.*, suppl. note, livr. XXI, Oct. 1820. Based on a living animal from an unknown locality. Later identified (in the supplemental note) as similar to another living specimen known to have been brought from Brazil.

Felis mitis Desmarest, Mamm., I, 1820, p. 221 (part) = *Felis mitis* F. Cuvier, plus the *Chibigouazou* of Azara = *Felis chibigouazou* Mearns (ex Griffith).

? *Felis elegans* Lesson, Cent. Zool., 1830, pp. 69–72, pl. xxi. "Brésil," without definite locality. Unidentifiable, but probably referable to some form of the *tigrina* group.

[1] The following forms of the *Margay* group are represented in the American Museum collection:

Margay glaucula (Thomas).

Felis glaucula Thomas, Ann. and Mag. Nat. Hist. (7), XII, p. 235, Aug. 1903. Type locality, Beltran, Jalisco, Mexico.

Margay tigrina oncilla (Thomas).

Felis tigrina Alston, Biol. Centr.-Am., Mamm., p. 61, Nov. 1879. Central America, including Volcan de Irazú.

Felis pardinoides oncilla Thomas, Ann. and Mag. Nat. Hist. (7), XII, p. 237, Aug. 1903. Type locality, Volcan de Irazú, Costa Rica.

Margay tigrina andina (Thomas).

Felis tigrina Thomas, Proc. Zool. Soc. London, 1880, p. 396, Andoas, Ecuador, Buckley Coll.

Felis pardinoides andina Thomas, Ann. and Mag. Nat. Hist. (7), XII, p. 238, Aug. 1903. Type locality Jima, Province of Azuay, Ecuador, Buckley Coll.

EMBALLONURIDÆ.

76. **Rhynchiscus naso** (*Wied*).

Twenty-five specimens: Calama, 9 skins and skulls and 5 specimens in alcohol; Porto Campo, 1 skin and 10 in alcohol.

Collector's measurements of 14 Calama specimens: Head and body, 56.3 (50–60) mm.; tail, 14 (12–15); foot, 7 (6–8); ear, 9.3 (9–10); expanse, 245.3 (235–260).

77. **Saccopteryx bilineata** (*Temminck*).

One specimen, Barão Melgaço.

PHYLLOSTOMIDÆ.

78. **Mormon bennetti** (*Gray*).

Two specimens, Urucúm.

79. **Glossophaga soricina microtis** *Miller*.

Nine specimens, all from Urucúm.

Collector's measurements: Head and body, 64.6 (59–70) mm.; tail, 10 (8–12); foot, 10.1 (10–11); ear (from crown), 10.6 (10–12); expanse, 257 (245–270).

80. **Vampyrops lineatus** (*E. Geoffroy*).

Thirty-two specimens: Urucúm, 30 skins and skulls and 4 in alcohol; Trinidad, Paraguay, 2.

Collector's measurements of 28 adult Urucúm specimens: head and body, 71 (70–75) mm.; foot, 11.4 (12–13); ear, 14.8 (13–15); expanse, 350 (330–370).

Margay tigrina emerita (Thomas).

Felis pardinoides emerita THOMAS, Ann. and Mag. Nat. Hist. (8), X, p. 43, July, 1912. Type locality, Montes de la Culata, Merida, Venezuela.

Margay tigrina elenæ Allen.

Margay tigrina elenæ ALLEN, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 631, Dec. 30, 1915. Type locality, Santa Elena, Antioquia, Colombia.

It seems to me quite doubtful whether these forms are all conspecific, especially *emerita* and *andina*.

81. **Artibeus jamaicensis lituratus** (*Illiger*).

Five specimens: Rio de Janeiro, 4; Urucúm, 1.

82. **Artibeus concolor** (*Peters*).

A skin, without skull, from Calama, is provisionally referred to this species.

VESPERTILIONIDÆ.

83. **Eptesicus chapmani** *Allen*.

Five specimens, Lower Solimoens. (*Cf.* this Bull., XXXIV, p. 632, 1915.)

MOLOSSIDÆ.

84. **Molossops temmincki** (*Burmeister*).

Seven specimens: Tres Burity, 2; Lower Solimoens, 5 (including 2 in alcohol).

Collector's measurements of 3 adults from the Solimoens: Head and body, 86 (84–90) mm.; tail, 28.3 (25–30); foot, 10 (all 10); ear from crown, 9 (8–10); expanse, 238 (235–240).

85. **Molossus obscurus** *E. Geoffroy*.

Five specimens, all from Calama.

Collector's measurements of 4 specimens: Head and body, 110 (105–120) mm.; tail, 43.7 (40–50); foot, 10 (all 10); ear from crown, 9 (8-10); expanse, 309 (300–320).

86. **Molossus cherriei** *Allen*.

One specimen, Tapirapoan (Cherrie). (*Cf.* this Bull., XXXV, p. 529, July 24, 1916.)

CALLITHRICIDÆ.

87. **Callithrix argentata melanura** (*E. Geoffroy*).

Jacchus melanurus E. GEOFFROY, Ann. du Mus. d'Hist. nat., XIX, 1812, p. 120 ("Le Bresil?").— DESMAREST, Mamm., I, 1820, p. 93. Description based on Geoffroy's type.

Hapale melanura Kuhl, Beitr. Zool. u. Comp. Anat., 1820, p. 49. Description based on Geoffroy's type.— Wagner, Schreber's Säugt., Suppl., I, 1840, p. 244; Abhandl. m.-p. Classe, k.-b. Akad. Wissen. München, V, 2 Abtheil., 1848, p. 469; Schreber's Säugt., Suppl. V, 1855, p. 127 (part).— Sclater, Proc. Zool. Soc. London, 1875, p. 419 (part, not the plate).— Pelzeln, Verhandl. k.-k. b.-z. Gesells. Wien, XXIII, Beiheft, 1883, p. 23, Matto Grosso, Brazil.

Callithrix argentata Elliot, Primates, I, 1912 (1913), p. 221 (part; description, but not the plate).

Four specimens, 2 adult males, 1 adult female, 1 young male in first pelage, all from Urucúm, Matto Grosso, Nov. 27, 1913.

Collector's measurements of adults: Total length, ♂♂, 565, 560, ♀ 580 mm.; tail vertebræ, 340, 340, ♀ 340; hind foot, 70, 68, ♀ 70.

Skull, occipitonasal length, ♀ 44.6, ♂♂, 43.5, 44.6; zygomatic breadth, ♀ 30, ♂♂, 29.7, 30.3; orbital breadth, ♀ 27, ♂♂, 26.5, 26; postorbital breadth, ♀ 21.5, ♂♂, 21, 22; breadth of braincase, ♀ 25.4, ♂♂ 25, 26.

These specimens agree with Wagner's (*l. c.*, 1848 and 1855) and Natterer's (Pelzeln, *l. c.*, 1883) descriptions of specimens collected by Natterer at Cuyubá and Caiçara, Matto Grosso.

Geoffroy's *Jacchus melanurus* was based on a single specimen without definite locality but supposed to have come from Brazil. His diagnosis comprised seven words, as follows: "Pelage brun; fauve en dessous: queue noire"; to which he added, "Habite . . . . le Bresil?" In 1820 Desmarest and Kuhl each gave a fuller description based on Geoffroy's type in the Paris Museum.[1] This description agrees well with Matto Grosso specimens, and Cuyubá is here designated as type locality for the species, which was first fully described by Wagner in 1848 and in 1855 from Natterer's large series of Cuyubá and Caiçara specimens.

Simia argentata Linné (Mantissa, 1771, pt. 2, p. 521) was based primarily on the Mico of Buffon (Hist. nat., XV, 1767, pp. 121–124, pl. xviii), which in turn was described from a dried skin, formerly for a time preserved in spirits,[2] obtained at Para, Brazil, by Condamine, and apparently full-grown (about "huit pouces de longuer depuis le bout du museau jusqu'à l'origine de la queue"). It is described as "de couleur grise-blanchâtre & tres-légèrement teinte de jaunâtre" upon all the body, "excepté sur la queue, dont le poil est court & de couleur de marron ou noirâtre." Buffon says he had been assured by Condamine, who had seen the species alive, that the ears and face were of the color of vermilion, and they are so represented in Audebert's plate (*l. c.*). The color of the face and ears is doubtless much less bright, even in life, than is here represented. It seems probable that Sclater's colored plate[1] (P. Z. S., 1875, p. 419, pl. 1), from a living animal in the menagerie of the London Zoölogical Society, from an unknown locality, and identified by him as *Hapale melanura,* represents the normal coloration of true *argentatus.*

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[1] This type was still in existence in 1851, and is entered in I. Geoffroy's 'Catalogue' of the Mammals (p. 60) as follows: " ♂ *Type de l'espèce.* Du Brésil; du Voyage de M. Geoffroy Saint-Hilaire en Portugal, 1808."

[2] *Cf.* Audebert, Hist. nat. des Singes et des Makis, 1800, Fam. VI, Sect. II, p. 3, pl. ii.

It may be here noted that I. Geoffroy[2] believed that *Simia argentata* Linné, *Le Mico* of Buffon, and the *Jacchus*, or *Hapale, argentatus* of E. Geoffroy and of later authors, is merely "une variété albine de l'Ouistiti." A specimen in the Paris Museum from Brésil, presented by Count Hoffmansegg, he believed was also 'un *H. melanurus* albinos."

A specimen of the *melanurus* group taken in Bolivia, was presented to the Paris Museum as early as 1834, and another was collected there a little later by Bridges, which became the basis of Gray's *Jacchus leucomerus,*[3] and which should probably now stand as *Callithrix argentata leucomerus* (Gray).

Since the above was written the American Museum of Natural History has received three specimens of the *Callithrix argentata* group, two of which are from the Lower Amazon region, one being from Cametá, on the Rio Tocantins, the other from Tamacurý, Amazonas. The first has the upperparts and limbs faintly washed with silvery gray; the other similarly washed with a dusky tone of gray; the tail in both is black with a slight mixture of white hairs, most abundant near the tip. These specimens closely resemble the type specimen of *argentata,* except that the tail is deep black instead of "marrou ou noirâtre.' The third specimen is from Pimental, Rio Tapajos, and is white with a faint suffusion of yellow, strongest on the hind limbs and tail. This specimen agrees perfectly with the description of *Hapale chrysoleucos* Wagner (ex Natterer MS.), based on specimens from Borba, on the lower Rio Madeira. Of Natterer's seven specimens, one is noted as having traces of black on the upper side of the tail. *Hapale chrysoleucos* is probably merely a local form of *Callithrix argentata,* which is apparently an unstable group, as yet not well understood.

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[1] Well reproduced by Elliot in his 'Primates,' Vol. I, pl. 8.

[2] Cat. méth. Coll. des Mammifères du Mus. d'Hist. nat. de Paris, 1851, p. 60.

[3] Ann. and Mag. Nat. Hist., XVIII, p. 212, Sept. 1846.

CEBIDÆ.

88. **Alouatta caraya** (*Humboldt*).

Four adult specimens: Urucúm, 2, male and female; Rancho Palmiras, Rio Taquary, 2 males.

Collector's measurements: total length, male and female, Urucúm, ♂ 1260, ♀ 1100 mm.; head and body, 610, 500; tail vertebræ, 650, 600; hind foot, 145, 140. (The external measurements of the Rancho Palmiras specimens are not available.)

Skulls of the same specimens, total length,[1] ♂ 121, ♀ 102; occipitonasal length, 110, 85; basal length, 102, 84; zygomatic breadth, 79, 67; orbital breadth, 59, 53; interorbital breadth, 11, 9; postorbital breadth, 38, 38; breadth of braincase, 48, 48; breadth of rostrum at canines, 28, 22; palatal length, 41, 36; palatal length at m^1, 23, 20; nasals, 22 × 13, 17 × 10; maxillary toothrow, 34, 30. Two old male skulls from Rancho Palmiras: Total length, 127, 128; occipitonasal length, 111, 112; basal length, 107, 105; zygomatic breadth, 85, 85.5; orbital breadth, 61, 64; interorbital breadth, 11, 14; postorbital breadth, 39, 40.5; breadth of braincase, 54, 53; breadth of rostrum at canines, 29, 30; palatal length, 46, 43; palatal breadth at m^1, 23, 23; nasals, 24 × 11, 23 × 11; maxillary toothrow, 37, 36.5.

89. **Saimiri cassaquiarensis** (*Humboldt*).

Two specimens: Calama, lower Rio Madeira, 1, adult female; lower Rio Solimoens, 1, adult female.

Collector's measurements: Total length, 750, 700 mm.; head and body, 290, 335; tail vertebræ, 460, 405; hind foot, 90, 80; ear from crown, 20.

90. **Saimiri ustus** *I. Geoffroy*.

One specimen, adult male, Calama, lower Rio Madeira.

Collector's measurements: Total length, 750 mm.; head and body, 310; tail vertebræ, 440; hind foot, 90; ear from crown, 30.

Skull, total length, 65; occipitonasal length, 60; zygomatic breadth, 38; orbital breadth, 35; postorbital breadth, 31; breadth of braincase, 36.5; maxillary toothrow, 12.2; depth of skull at bullæ, 33.

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[1] To end of occipital spine, which in males projects about 8 mm. beyond the occipital plane.

91. **Ateles longimembris** *Allen.*

Two specimens, Barão Melgaço, Matto Grosso. (*Cf.* this Bull., XXXIII, p. 651, 1914.)

92. **Aotus azaræ** (*Humboldt*).

Four specimens: 2 adult females and a very young specimen, Rio Pilcomayo, at mouth of Rio Negro, about 100 miles west of Asuncion, Nov. 13, 1913; 1 flat skin, Province of Buenos Ayres, Argentina.

Collector's measurements, total length, 750, 730 mm.; head and body, 360, 330; tail vertebræ, 390, 400; hind foot, 100, 105.

Skulls, occipitonasal length, 59, 58; total length, 63, 60; zygomatic breadth, 33.9, 41; orbital breadth, 44, 43; postorbital breadth, 31, 32; breadth of braincase, 34.5, 34; maxillary toothrow, 14.3, 14.7.

One of these specimens has the pelage of the upperparts much more heavily suffused with fulvous than the other, and the underparts are also paler. In the heavily suffused specimen the base of the tail above is deep ochraceous, in the other the base of the tail has a paler tone of ochraceous and the ochraceous area is much more restricted.

93. **Aotus roberti** *Dollman.*

Two specimens, adult male and female, Rio São Lourenço, Upper Paraguay, Matto Grosso, Jan. 1, 1914.

Collector's measurements, total length, ♂ 790, ♀ 760 mm.; head and body, ♂ 360, ♀ 360; tail vertebræ, ♂ 430, ♀ 400; hind foot, ♂ 100, ♀ 100.

Skulls, occipitonasal length, ♂ 59, ♀ 58.7; total length, ♂ 61, ♀ 60; zygomatic breadth, ♂ 39.2, ♀ 39.6; orbital breadth, ♂ 44, ♀ 45; postorbital breadth, ♂ 31, ♀ 33; breadth of braincase, ♂ 33, ♀ 34.5; maxillary toothrow, ♂ 14, ♀ 14.5.

A. roberti, on the basis of these specimens, has the upperparts a much darker, clearer gray, without any marked fulvous suffusion, than *A. azaræ,* with a distinct blackish superciliary streak, absent in *azaræ.* The skulls of these two species have practically the same size and general proportions, but the interorbital region is much broader, with a correspondingly wider palatal region, in *azaræ.* Also the dentition is heavier and the maxillary toothrows are more convergent anteriorly, and the audital bullæ much less inflated than in *roberti.* In *roberti* the bullæ are not only much smaller, but the inner face is concave, instead of flat as in *azaræ.* The lower jaw is also much heavier in *roberti,* the angular portion being especially broader and heavier.

94. **Cacajao roosevelti** *Allen.*

Three specimens, Barão Melgaço, Matto Grosso, head of the Rio Gy-Paraná. (*Cf.* this Bull., XXXIII, p. 651, 1914.)

95. **Lagothrix cana** (*Humboldt*).

Two specimens, adult male and female, Calama, lower Rio Madeira.

In these specimens the pelage is very short, with no very long hairs on the limbs, tail, or chest. The general coloration above is dull olivaceous gray, with a well defined dark brown crown-patch; ventral surface and inside of limbs dark brownish black, lighter on chin, throat and chest, darker, nearly black, on the lower abdomen.

Collector's measurements of the female: Total length, 1140 mm.; head and body, 480; tail vertebræ, 660; hind foot, 140. The male was not measured.

96. **Cebus macrocephalus** *Spix.*

Two specimens, adult male and female, Calama, lower Rio Madeira.

Collector's measurements, total length, ♂ 945, ♀ 860 mm.; head and body, 465, 430; tail vertebræ, 490, 430; hind foot, 135, 115. Skulls, total length, ♂ 99, ♀ 88; basal length, 71, 62; zygomatic breadth, 71, 60; orbital breadth, 56, 45; interorbital breadth, 6, 4; postorbital breadth, 36, 37; breadth of braincase, 52, 51; breadth of rostrum at canines, 30, 28; palatal length, 34, 30; breadth of palate at m^1, 19, 16; nasals, — × 16, 18 × 9; maxillary toothrow, 23, 22.

97. **Cebus azaræ azaræ** *Rengger.*

Seven specimens: Urucúm, 5, Dec. 7–12, 1913; San Lourenco, 2, Dec. 31 and Jan. 1, 1913–14. Four of the specimens are adult, the others are immature, one of them apparently not more than a week or two old.

Four adults, 2 males, 2 females: total length, San Lourenço, ♂ 880, Urucúm, ♂ 920 mm.; Urucúm, 2 ♀ ♀, 890, 870; head and body, ♂♂ 450, 420; ♀ ♀ 420, 440; tail vertebræ, ♂♂ 470, 460; ♀ ♀ 470, 430; hind foot, ♂♂ 130, 110; ♀ ♀ 120, 110.

An adult male and an adult female skull measure as follows: Total length, ♂ 96, ♀ 89; basal length, 66, 59; zygomatic breadth, 67, 58; orbital breadth, 53, 46; interorbital breadth, 5, 4; postorbital breadth, 38, 35; breadth of braincase, 53, 50; breadth of rostrum at canines, 28, 25; palatal length, 33, 30; breadth of palate at m^1, 17, 15; nasals, 19 × 11, 15 × 9; maxillary toothrow, 22.3, 21.5.

FIELD NOTES. BY LEO E. MILLER.[1]

2. **Didelphis paraguayensis.** PARAGUAY OPOSSUM.

Very abundant in the tall forests and in swampy country. No. 57, taken on the Rio Negro, Paraguay, was carrying fourteen young. The specimens trapped in the Paraguayan Chaco had almost buried themselves beneath the leaves and earth. It is possible that this may have been done as protection against the mosquitoes which swarmed in clouds. The tip of the tail of one of the trapped animals, protruding above the leaves, was covered with these insects. They are nocturnal in habits, spending the day in hollow trees and in hollow logs. Their food consists of both fruits and flesh, and they seem to be fond of carrion and fish. The former is effective as bait in trapping them, and they frequently visited camp in search of the latter, attracted by the drying mammal skulls.

4. **Metachirus opossum quica.** QUICA OPOSSUM.

This small species of opossum is found in the deep forests. I have never known it to venture near houses for the purpose of robbing hen-roosts and nests, like its larger relative, although it may do so. When trapped it does not feign death, but fights viciously, biting at any object within reach, and holding on until its strength fails. They do not hesitate to bite iron bars or steel trap, even though it may break the teeth. Very tenacious of life and will frequently recover from the effects of a blow after having been apparently lifeless for some time. As a general rule opossums cannot stand great heat, and will soon die if left exposed to the direct rays of the tropical sun. The number of young is usually small, between three and eight, and they are carried in a pouch.

5. **Peramys** sp.? PYGMY OPOSSUM.

Not abundant. The single specimen was taken in a native hut at Urucúm, where it was prowling about much in the manner of a mouse. The natives could not distinguish between it and the common house mouse, and insisted that it was the latter.

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[1] [The numbers at the left of the systematic names are those used in the preceding 'Systematic List,' and serve as cross-references.— J. A. A.]

7. **Myrmecophaga tridactyla.** GIANT ANT-EATER.

We found the giant ant-eater, or tamanduá bandeira, not rare, although far from being abundant, on the Rio Taquary (fazienda Las Palmeiras). This occasioned, some surprise as the district is in the heart of the great pantanal country, and termites are comparatively scarce. As the great creature gallops clumsily along, the enormous flattened tail is thrown up, and doubtless aids in balancing the animal. One was running in several inches of water. When pursued by dogs, it runs until closely pressed, when it will turn and, rearing, make short dashes at them. We saw them in broad day-light, although they are supposed to be nocturnal in habits. Lydecker[1] says its habits are nocturnal and that it has "usually a regular lair.... generally situated among tall grass, where it spends the day in slumber. . . ." In the same paragraph he speaks of the animal tearing open the hillocks of termites with the powerful claws of the forefeet. And "as soon as the light of day is let into their domicile, the ants or termites rush to the surface. . . ."

Without commenting on the inconsistency, I believe the giant ant-eater is at least partially diurnal. The stomachs of the specimens collected by Col. Roosevelt and Kermit Roosevelt contained ants and termites, a quantity of earth, and bits of dry and green leaves. Col. Roosevelt expressed the opinion that the earth and leaves were picked up with ants. The walls of the stomach are thick and muscular, like the gizzard of a fowl. In captivity they thrive upon finely chopped meat.

8. **Dasypus novemcinctus.** NINE-BANDED ARMADILLO.

In some parts of South America the nine-banded armadillo furnishes a regular supply of food, and is on sale in the village markets. They are hunted at dusk as they come out of their burrows in quest of food, although they are frequently met with in the daytime, bounding across fields or so engrossed in digging under a stump or root that they may be taken up in the hand. When captured, the animal struggles violently and is capable of inflicting serious injury with its great claws. It must be held by the tail, and so great is its strength that it frequently escapes from its captor and bounds away at great speed. Four young are produced at a time.

10. **Euphractus sexcinctus gilvipes.** HAIRY ARMADILLO.

Very abundant about the plantations where they do a great deal of damage to sprouting corn. The method of catching them is to dig pits for them to fall into. At Urucúm we cleared a path 1000 meters long and 1 meter wide, along one side of a corn field, and sunk four salt barrels at equal distances apart in this cleared space. The tops of the barrels used were covered with dry grass. Grains of corn were scattered along the trail and a liberal amount sprinkled on the grass covering the pits. The armadillos in their excursions to and from the corn fields, in crossing the trails, were attracted by the corn, and in following its line plunged down into the barrel. We caught several in this manner. Don Cesar, our host, had at one time owned a live jaguar who subsisted entirely on the armadillos caught for him in this manner. This hairy armadillo is vicious and fights with both teeth and claws. Probably mostly nocturnal in habits, spending the day in holes in the ground, but I have seen them out as late as 9 A.M.

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[1] Royal Natural History, Sect. V, p. 212.

11. **Cabassous loricatus.** SOFT-TAILED ARMADILLO.

Collected by Col. Roosevelt who encountered the animal one morning while following a trail through the forest.

13. **Pecari tajacu.** COLLARED PECCARY.

Collared peccaries seem to be much more abundant and more widely distributed than the white-lipped species.[1] Where they are plentiful, great areas of the forest floor is uprooted, and they leave behind them a trail of partially eaten fruits. They seem to travel continually. If a female with young is shot, the young will not leave and may easily be caught. They become tame immediately and follow at the heels of their master all day long, keeping up a shrill squealing. Even when grown they remain tame, and always return to the huts from the forest where they go to feed. They move silently, like a shadow, and keep up a deep, moaning grunt that is hardly audible. I have known them to attack strangers and dogs.

15. **Blastocerus dichotomus.** SWAMP DEER.

The largest deer found in South America, and apparently quite abundant in the vast pantanal country of southwestern Brazil, where its long hoofs enable it to walk on the boggy soil and penetrate into the dense swamps. Seen singly and in pairs, and all I saw were very tame. One, a doe that had just emerged from a papyrus swamp, permitted my companion and myself to ride to within twenty yards of her before stalking slowly away.

[[1] Both species are represented in the Roosevelt Collection, but Mr. Miller's notes relate only to the collared peccary.— J. A. A.]

We made no attempt to follow her, but it is possible that she may have had a fawn concealed nearby.

The scent gland in the fore-feet is highly developed, and the antlers are large and exceedingly heavy.

16. **Blastocerus bezoarticus campestris.** Pampas Deer.

While riding through the great Chapadón, we frequently came upon this beautiful little creature, singly and in small parties. There were no fawns at this season (February). The vast stretches of grass-covered country, with its thin growth of gnarled, stunted trees seemed to furnish the ideal home for this species. Usually we first saw them slowly pacing back and forth, watching us with alert eyes. As we drew nearer, to within two hundred yards, they would make off at a great pace, the white tail flickering, in the most suspicious manner possible.

The flesh of this species is of an exceedingly delicious flavor, being much better than that of the various other species of South American deer with which I am acquainted.

17. **Mazama rufa.** Red Brocket.

Fairly abundant around Urucúm. They spend the day in the forest or dense low thickets and wild banana brakes. At dusk they come out of cover and devastate the plantations. They are particularly fond of growing beans, of which deer will destroy a great quantity in one night. The native way of ridding themselves of the plunderer is to erect a high platform on poles, in the center of the field, commanding a view of all sides, and as the animal emerges, it is shot. They also feed in the early morning.

18. **Mazama simplicicornis.** Brown Brocket.

Abundant in the deep swamps. Found early in the morning, feeding in the open country. They probably travel a great deal, or at least move about over a large area, as the vast open spaces are covered with tracks. Sometimes these lead to human habitations as if the animal had been attracted by curiosity.

19. **Tapirus terrestris.** Brazilian Tapir.

About the base of Mount Duida tapirs were fairly abundant. While waiting for squirrels, I saw them moving singly through the forest and fording the shallow Rio Sina like shadows, so quietly did they move. If disturbed, they crash through the forest at a quick trot and even gallop.

I do not believe that tapirs are nocturnal, as I have seen them at nearly all hours of the day. When undisturbed they leave the forest and feed on the succulent mosses that cover the rocks along the rivers.

It is said that the tapir trails lead under vines and dense brush, so that if the animal is attacked by a jaguar it can rush through the "tunnel" and scrape off its assailant. But it seems as if trails of any length must lead through such thickets anyway, on account of the very nature of the tropical vegetation, so these 'tunnels' may not be made designedly after all.

The tapir swims and dives well, and often takes to the water when pursued. It is said that before diving, the tapir thrusts its long, flexible nose into its mouth in order to exclude the water. Should one be shot in deep water, it sinks, but rises to the surface in a few hours.

The skin is tough and thick, with a sparse covering of hair. Usually the animals are infested with vast numbers of ticks. The flesh is greatly esteemed as food.

I have seen traces of tapirs up to an altitude of 13,000 ft., although I have never collected one at that altitude. But the trails that led from the low dense brush growth on to the grassy paramo were trampled like broad cow tracks. They were said (by the Indians) to descend to the salt springs lower down, at certain regular intervals during the year. I have seen numerous "wallows" where they had lain.

In Colombia the tapir is called Danta; in Venezuela, Maipure; in British Guiana, Bush Cow; in Brazil, Tapiro or Anta.

Along the Sepotuba we found two apparently different species.[1] One species, of which we took two specimens (apparently adult ♂ and ♀), was much smaller and lighter in color than the female of the larger species shot by Col. Roosevelt.

The stomachs I examined contained mostly palm nuts with seeds the size of hens' eggs. The pulp surrounding the seed had been masticated but the hard, large seeds were entire. There was also grass.

Col. Roosevelt called our attention to the fact that in the Old World (except the Malays) the horse (coming from the north?) completely replaced the old ungulates, even in North America. In South America, the tapir survived while the horse became extinct.

20. **Sylvilagus paraguensis.** RABBIT.

Not abundant. Found in the mandioca fields, near Trinidad, Paraguay.

[[1] There proved to be only one.— J. A. A.]

22. **Cavia rufescens pamparum.** Cavia.

Early each morning and at dusk, these animals appeared in considerable numbers on the edge of a great meadow of tall grass. Numerous trails had been tramped through the grass, and the ground was covered with their footprints and excrement. At the edge of the meadow a space had been cleared in building a small railway, and to this open spot they came apparently to play. Usually seen in small parties, often consisting of young and old. There were individuals of all sizes, from very small to adult. One morning, in sneaking around a corner at the edge of the field, I came face to face with a large ocelot, engaged in a like manner. Evidently the cavies were being stalked and killed by the big cat. I later discovered a wide patch through the field, near the edge of the forest, down which the ocelots seemed to come regularly for their supply of food.

25. **Hydrochœrus hydrochœrus.** Capybara.

Inhabits eastern South America and extends into Peru and Bolivia. Abundant in the Cauca Valley, Colombia. Fond of the grassy river banks, thickets, and brush-dotted marshes. Also found along the edges of swamps and in wild cane jungles.

It may be seen at all hours of the day, but more often in the early morning and late afternoon, apparently keeping to the thick cover during the hottest part of the day. On moonlight nights they can be found swimming in the water, and diving from the high banks. Only the nose is visible when they swim, and frequently they swim a long distance under water.

The food consists entirely of vegetable matter and in many places the animals are very destructive to crops, especially sugar cane. Wide lanes are felled in the cane-fields, and much that is not eaten is trampled upon and ruined. If persistently persecuted they become wary, and emerge from their hiding places only during the darkest part of the night.

The flesh, as a general rule, is not eaten by the natives. It possesses an exceedingly disagreeable odor, and the taste is said to be unpleasant. In the vicinity of the Rio Suaza, Colombia, it is claimed that persons partaking of the flesh will break out with sores and ulcers, but I cannot vouch for the truth of the statement.

26. **Dasyprocta agouti leptura.** Agouti.

A shy, nervous little creature that is said to live only in the higher country some distance from the water, on the dry hillsides.

29. **Dasyprocta variegata urucuma.** AGOUTI.

I have invariably found the agouti more plentiful in low, wet country than in the dry forests. Also met with along the grassy banks of streams, and in the thick brush at the edge of the forests. In British Guiana agouti are hunted from canoes. Dogs are sent into the forest to start the animals, which take to the water, swim a short distance, then scramble back up the bank. They are shot upon leaving the water. The flesh is greatly esteemed as food.

31. **Dasyprocta (Myoprocta) exilis.**

Not abundant on the Rio Negro and Rio Solimoens. In the Caquetá I found them [*Dasyprocta* (*M.*) *exilis milleri*] apparently living in colonies, in wet forests. They were out and about in the mornings, and took refuge in holes in the river bank. The flesh is white and possesses a delicious flavor.

32. **Ctenomys nattereri.** CURURÚ.

The first indications of the cururú were seen at Tapiropoan where several of their mounds were scattered about through a strip of sandy country. After that we came across their work but two or three times in all the five hundred mile ride across the state. Then, near the end of our long overland trip, at José Bonefacio, we struck a strip of sandy country in which the animal seemed to be comparatively numerous. The mounds were thrown up at irregular intervals of from a few feet to ten yards apart, and some were very large, being all of three feet across and eighteen inches high. The country was treeless, with a growth of grass and patches of wild pineapples.

We had no trap suitable for this class of animal, so with six Nhambequara Indians, I proceeded to dig for one. At first the Indians, guided by the mounds and aided by a sharpened stick, followed the galleries, which were about a foot beneath the surface, and at intervals of ten yards blocked them by stamping down the earth into the hole. We returned a half hour later and found that the plug between two of these sections had been opened so knew just where the creature was bottled up.

The Indians now opened the entire section of the gallery, and found a hole going almost straight down, which they explained led to the nest. A soldier was now called with a hoe, and the work of excavation was begun. In order that the hole might not be filled up, a long, pliable stick was inserted, and this served as a guide. The Indians worked with pointed sticks, and threw out the loose earth with their hands. Frequently they relieved each other. And when, near the end of the work, the animal could be felt with the stick, they became greatly excited and worked in feverish haste, as a fox terrier might after a rat, and kept up a continuous yelling. They were covered with earth from head to foot; ears, eyes, nose and hair were caked with sand and clay, and the naked bodies looked as if they had just emerged from a mud wallow. Finally one threw away his stick, inserted his arm into the hole, and with a yell of triumph jumped up, holding aloft the kicking little creature by the tail. Then he flung it from him into the grass. The animal seemed bewildered above ground and could not run fast.

The hole after leaving the upper gallery descended eight feet, then ran in a horizontal direction fifteen feet. At the end was a small cavity, but no nest. Small bunches of grass were found in the gallery which had been pulled down by the roots.

The excavation measured 15 feet long, 8 feet deep and 3 feet wide, and it required half a day for the Indians to complete the work.

The Indians are fond of the animal's flesh, and often dig them out to eat.

33. **Proechimys longicaudatus.** Spiny Rat.

Apparently an inhabitant of the dense forest where the ground is covered with thick layers of leaves and brush.

34. **Proechimys kermiti.** Large Spiny Rat.

Only one individual of this species was observed. Taken on the edge of the virgin forest, in a corn field.

36. **Epimys rattus alexandrinus.** Roof Rat.

Abundant in native huts, together with *Epimys rattus.*

38. **Neacomys spinosus amœnus.** Spiny Mouse.

Apparently arboreal, and numerous. Taken at the base of a tree.

42. **Oryzomys angouya.** Field Rat.

Frequents the bromelia and wild pineapple thickets of the dry country surrounding Asuncion, Paraguay. Not abundant.

48. **Oryzomys (Oligoryzomys) mattogrossæ.**

Taking the place of the common house mouse, this mouse[1] was found in the huts of the Indians. But it was more abundant in unused houses, and in the store houses in the fields containing corn used in making mandioca. Seems to live in the thatched roofs.

49. **Zygodontomys tapirapoanus.** FIELD RAT.

Plentiful in the native corn fields. At least partially diurnal. Lives in holes that have been dug beside stumps, under logs, and more often beneath low clumps of dense bushes.

52. **Nectomys squamipes.** LARGE FIELD RAT.

At the rubber camp Urupá, I found this species numerous in the buildings. But one day below, at a camp known as La Pena, it was apparently replaced by the black rat and the common brown rat. I could not ascertain whether either species penetrated into the domains of the other or not, as my stops were too short.

56. **Tayra barbara gulina.** TAYRA.

An inhabitant of the tree tops. Said to be fairly abundant, but rarely met with.

62. **Nasua nasua solitaria.** COATI.

An animal of the heavy forest, spending much of its time in the trees, but being also partially terrestrial, especially at night. Omnivorous, feeding upon insects, young birds, fruits, and apparently upon fish and crabs as their tracks are frequently seen along water-ways. I have found them frequently at an altitude of 10,000 feet, and in the cold, lofty Valle de las Papas, they had well-worn trails across the open patches of grass between the tree clumps. The trails were stained almost black and had a decided, unpleasant odor. Hunted with dogs, the coati fights savagely, and often fatally injures its canine pursuers. The claws are its most effective weapons. They are easily domesticated and become very tame but are more or less of a nuisance on account of their mischievous and unclean habits.

[[1] These remarks probably apply to the small, long-tailed mice of the subgenus *Oligoryzomys* collectively, of which three species were collected by Mr. Miller in Matto Grosso.— J. A. A.]

64. **Chrysocyon jubatus.** Red Wolf.

Of all the larger South American mammals, the great "guaraguasú" is probably the rarest, and the least often met with. Very little is known of its habits, even by the natives and Indians who are usually so prolific with stories about the wild creatures coming under their observation. My own experience is limited to hearing the strange, weird cry at night-fall, and seeing the tracks along the trail as we rode through the Chapadon of Matto Grosso.

They are said to live singly, frequenting the chapadon and papyrus marshes, and to travel great distances in quest of the rabbits, cavies and other small mammals that form their principal items of food.

65. **Cerdocyon thous azaræ.** Gray Wolf.

Found singly, and rarely in pairs, in the vicinity of Asuncion, Paraguay, along the Paraguay River, although its range is doubtless more extensive. Inhabits both the forest and brush-dotted plains.

73. **Oncoides pardalis chibigouazou.** Ocelot.

A series of six skins was presented to the mammal collection by the Brazilian Land, Cattle and Packing Co. All were taken on the Upper Paraguay where it is quite abundant. The variation in the pattern of the coloration is very great.

The ocelot is of a rather bold disposition, coming to native huts at night, and robbing the hen roosts. They are said to fight viciously when driven to close quarters.

In the Paraguayan Chaco I came upon one not more than twenty feet away. It made no attempt to move, but looked defiantly until shot. Being wounded by a first shot, it attempted to escape.

In the Caquetá (Colombia) region one that was seen climbing through the forest not far away did not increase its speed nor manifest fear at sight of man.

74. **Margay tigrina wiedi.** Tiger Cat.

Probably not very abundant. The specimen collected [near Urucúm] was surprised along the trail on the mountainside, and immediately started up a tree, rapidly climbing about twenty-five feet, and clinging quietly to the side of the tree, permitting me to walk to within a short distance of the base of the tree.

76. **Rhynchiscus naso.** NOSE BAT.

This small bat is found in considerable numbers along rivers and in swamps. They cling flat against the tree trunks or stems of shrubbery, usually not far above the water. There may be from two to fifteen or more in a colony of both sexes. One may approach quietly in a canoe to within a few yards, when they will suddenly take wing and dart swiftly away among the dense vegetation. Usually they do not fly far and often come back to the same tree they left, but they invariably light on the far side and remain concealed. They rest close together, and are easily distinguished by their unusual shape, which does not in the least resemble growths of fungi or natural excrescences on the tree trunk.

77. **Saccopteryx bilineata.** BLACK-AND-WHITE BAT.

Not very abundant. Only seen occasionally about the native huts. Flight rather slow.

78. **Mimon bennetti.**

A number of tunnels have been bored into the sides of the low mountains in the vicinity of Urucúm, in search of iron ore. These supply sleeping places to which numbers of bats resort to spend the hours of daylight. Several species are found, each species seeming to occupy a different space from the others. Of the above-described species there were only three individuals, one of which escaped and did not return. The method employed in collecting was to enter a tunnel with a lighted candle in one hand and a stick in the other, and to knock down the bats as they flew by. At first they were loath to leave their hiding places in the crevices among the rocks. But after a few days' persecution, large numbers rushed from the tunnel and disappeared over the top of the mountain at the mere sight of the lighted candle in the entrance.

80. **Vampyrops lineatus.** STRIPED BAT.

With the break of day, these bats, in large numbers, came to a grove of mango trees beside the house [in Urucúm], and with much chirping and fluttering sought their resting places for the day. Usually small clumps of three to ten gathered in the clusters of leaves in the top of the trees, but on windy or rainy days they cling to the branches about half-way up. Usually the sexes were separate, and females with young were several times found clinging to the thick branches, ten to fifteen feet above the ground. Females without young were usually accompanied by males, in separate pairs.

The "leaf," nose and face, including the tips of the ears were tinged with delicate green.[1] If this was intended as protective coloration, it was of little or no value as the color could not be seen until the animal was held in the hand.

Other specimens of the same species were collected in the iron mountains at Urucúm. While similar to the striped bats taken in the mango trees, they showed only a very faint, or no trace of the green coloring on the face. I am convinced that the green color is not a vegetable stain, but that the pigment exists in the skin. It fades soon after death.

81. **Artibeus jamaicensis lituratus.** FRUIT BAT.

Found in palm trees in the botanical gardens of Rio de Janeiro. The two immature specimens were still clinging to the parent, and when shaken loose fluttered to the ground like a young bird. It is remarkable how the mother, encumbered with her offspring fully three-fourths as large as herself, can get about and procure food enough for the two, successfully competing with other individuals of the species which are free and unhampered and have only one mouth to feed. Perhaps the abundance of fruit in the tropics may account for this particular species' success in life. But it does not explain why the female of insectivorous species, catching their food on the wing, should not be at a great disadvantage while carrying large young, compared to the members of the opposite sex. It is true, nocturnal insects are plentiful in the tropics. On the Upper Orinoco I saw countless thousands of bats issue from the cracks between the great granite ledges, in a steady stream like smoke. Spruce[2] records that on one occasion he saw not less than a million, leaving a similar place. It does not seem probable that the individual range is very great, which would result in tremendous numbers being distributed over a comparatively limited area. Under such conditions there should be more or less of a struggle for existence, and an elimination of those individuals which are handicapped, or weak, in their competition with those strong and unhampered in their movements.

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[1] [Probably the green color here referred to was really fortuitous.— J. A. A.]

[2] Richard Spruce, 'Notes of a Botanist on the Amazon and Andes,' Vol. I, pp. 389–390.

Hemiderma perspicillatum. FRUIT-EATING BAT.[1]

On the Rio Pescador, Colombia, fruit-eating bats of a small species are so plentiful as to be decidedly destructive to the plantains and other fruits cultivated by the natives. Bananas and plantains had to be cut while still green. Upon showing the slightest traces of ripening, they are immediately devoured by the hungry hordes. Even when they are stored in tightly closed rooms, the bats would worm their way through crevices in the mud walls and do a great deal of damage.

By placing a few ripe bananas in my room, I attracted great numbers, that kept up a constant roar with their wings; occasionally one would alight with a thud, and then ensued much squeaking, fluttering, fighting and gnashing of teeth. Finally the turmoil would subside, and I could hear only a steady chorus of smacking and chewing. The next morning, only the skins of the bananas remained.

One night I placed a large bunch of ripe bananas in the center of the room, and suspended a circular throw-net above it from the ceiling. The sides of the net were drawn out and tacked to the floor, so that it formed a conical tent, in which lay the bananas. Soon bats began to pour through the open door and window in a steady stream, and circling around a few times landed on the net. Their attempts to get to the fruit through the small meshes of fine twine entangled them so that they could not escape. I brought in a lamp and sat down to watch. Many left the now lighted room, but others remained and continued their frantic efforts to reach the feast. In a short time I had trapped sixty. With the removal of the light, their numbers greatly increased again. In the darkened room I could stand close to the net, quietly removing the captives without disturbing the newcomers. They were all of one species, of both sexes, and I did not see or catch a single female carrying young.

84. **Molossops temmincki.**

While setting traps in a strip of woods near Tres Burity, my attention was attracted by a number of chirps or squeaks. To trace up the sound I burrowed into the rotten, crumbly log and discovered the two bats buried in the decayed wood. They were not under the bark, but buried deep in the heart of the tree, which was not hollow, and about three feet from the

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[[1] Not represented in the present collection, but many specimens were collected in Colombia by Mr. Miller.— J. A. A.]

end of the log. When uncovered they made no attempt to fly, but tried to crawl further in through the soft, spongy wood. It is possible that the log may have stood as a decayed stump, and fallen recently, and that the bats entered before it fell to the ground.

85. **Molossus obscurus.** Mastiff Bat.

At Calama, on the Madeira, a large colony of mastiff bats lived in the tile roof that covered the house. Frequently during the day we heard them scrambling along the tiles fluttering and squeaking. If we tried to poke them out with long poles, they hastily crawled to some inaccessible crevice. At dusk they issued forth in a broken stream, with a great deal of noise, and fluttered around the house and trees. There seemed to be a constant coming and going. Frequently they entered my room through the open doors and windows, and often in climbing about in a bewildered manner would invariably alight on the white lace curtains. The bright light seemed to stupify them, and I could take them in my hand. Occasionally one would drop through the tiles in the daytime in the course of a scuffle, but would invariably scramble back before we could get at it.

Desmodus rotundus. Blood-sucking Bat.[1]

I have found blood-sucking bats fairly common in parts of South America. On the Rio Agancho, Colombia, they bled our mules to such an extent that they were perceptibly weakened. The wounds were inflicted in the neck or shoulder, and bled considerably even after the bats had gone, as streaks of blood had run down to the ground and clotted. The natives said they had to keep their cattle and mules in another valley some distance away, or the bats would kill them. Fowls were provided with sleeping quarters screened with fine-meshed wire. I could not help wondering how wild birds and mammals escaped these pests, and it seems more than probable they do suffer to some extent.

Many instances of natives being attacked have come to my notice. The point from which the blood was withdrawn was a toe, finger-tip or the nose. Each stated that he had not been awakened by the onslaught, and that the wound had bled freely afterwards.

An acquaintance in British Guiana described how he had been bled repeatedly, and finally decided to lie awake and kill the creature. After awhile he heard a flutter, and something strike the covers some distance

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[[1] Not represented in the present collection, but collected elsewhere by Mr. Miller.— J. A. A.]

from his feet. He could feel the animal slowly working its way across the sheets, and when it reached his foot, he struck at it but missed. It fluttered about the room for some time, then returned. This was repeated a number of times, and always the bat alighted some distance away and crawled toward the point of attack. In one of the intervals he dozed for a few minutes, and awakened with a start to find that his assailant had taken advantage of the lapse of vigilance, and gorged itself at his expense.

It is said that blood-sucking bats vary their diet with insects. Also that they will not enter a room containing a lamp or burning candle.

87. **Callithrix argentatus melanura.** Black-tailed Silvery Marmoset.

These marmosets appear to be exceedingly rare, at least in the region where the present specimens were taken, as only one troop was observed. This consisted of about a dozen adult individuals. Three adults collected were two males and one female. One of the males was carrying two very small young, one of which was killed, the other living about a week. It took diluted sweetened milk from a spoon, but doubtless the change of diet caused its death. If placed upon a rough surface which afforded a hold for hands and feet, it would climb and run rapidly; but if placed on a smooth surface such as a table it trembled and was unable to move. The young 'chirped' frequently; but we heard no sound in the forests that could be attributed to the adults of this species.

88. **Alouatta caraya.** Caraya Howler.

The howlers constitute one of the most interesting groups of South American monkeys. I have found them abundant throughout Colombia, in British Guiana, down through Brazil, usually in the heavy forest, and in Colombia extending up in the mountains to at least 7000 feet. Along the Paraguay River we saw numbers of the black species in the thin, disconnected fringe of smallish trees along the river. There were pairs, or small troops of four to seven individuals. The howler travels rather slowly, and I have seen them walk to the end of a limb and deliberately drop into the top of a tree twenty or thirty feet below, without a moment's hesitation, followed by the other members of the troop in single file.

The red howler [*Alouatta seniculus caucensis* [1]] was particularly abun-

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[[1] For a systematic account of the red howlers (*Alouatta seniculus* group) see *antea*, pp. 228–231.—J. A. A.]

dant along the Rio Cauca (Colombia) and the Potaro River (British Guiana). On the Cauca I frequently saw them asleep in the tree tops, long after the sun was up. These I saw were not huddled together, but were sleeping some distance apart, where the rays of the sun could strike them. Of course it is possible that they may have assumed these exposed positions after daybreak in order to take advantage of the warmth of the morning sun.

In the late afternoon they were often found in the bamboos or other thick, low brush on the water's edge, possibly coming to drink.

The hoarse, reverberating roar may be heard at almost any hour of the day or night, though most often in the early morning or late afternoon. I believe that they do not travel at night, as a general rule, unless disturbed, when they may move off slowly and cautiously, roaring the while doubtless to intimidate their enemies. The roaring is begun by one individual, with a series of short, gruff barks, the others joining in the long-drawn cry that begins very low, rises rapidly in tone and volume, and then falls to the beginning note and stops abruptly.

When shot at they may run back and forth along the larger branches of the tree, or may make off rapidly. When wounded, they often attempt to conceal themselves in the clusters of leaves, or in the tops of palms. Sometimes they will simply grasp the bare branches for support and quietly await the end.

Should they fall to the ground, and be still living, they will fight savagely, and reach for their slayer with their hands. They are capable of inflicting severe bites with their strong teeth.

I have heard it said by the Indians, and have myself observed it in a few instances, that females with male young were separate from their mates and travelled alone, although the single male of the troop was somewhere in the neighborhood. The adult males are said to kill the young males if the latter are too small to care for themselves. I have taken females with small female young, accompanied by an adult male, or in a troop composed of both sexes. My observations are too few as yet to say that the above always is true. I do not know, and simply give the facts as I have noticed them. Only one young one seems to be produced at the time, but I know an instance where a female was shot with two small young.

The food consists mainly of fruits. They are fond of wild figs and wild cocoa.

In captivity they are sullen and usually soon die. I had one for a week at Riofrio, Colombia. It was tied to a sapling in front of our tent. One afternoon a large troop of its species were attracted to the spot, coming so silently that we did not know of their presence until small dry branches began to drop upon the fly of the tent. A few shots sent all but an old male scampering away. He took up a threatening attitude in a crotch sixty feet up, apparently intent upon rescuing the young which called lustily. We could not drive him away, so I shot him. He was the largest howler I ever saw and must have weighed forty pounds.

In British Guiana I kept a small red howler two months. It thrived on condensed milk, well diluted, and bread. In the daytime I usually gave her the range of the room, but she was never very playful or mischievous. The little face always looked sad and pathetic. It grew very tame, could be handled, would never attempt to bite, and came to take its food. At first it was fed from a fountain pen filler thrust through the wires of its box, to which it came of its own accord, sucking the milk from the glass point.

Afterward it sat many minutes looking at its reflection in a washbasin filled with water. If I stooped to talk to it, it would caress my face with its little black hands, the pitiful expression on its face never changing. Often it raised its voice in feeble imitation of the terrific howlings of its elders; when approached suddenly by a stranger, it shrank into a corner and screamed. Unfortunately just as I was about to leave the country it discovered the arsenic used in preserving bird skins, ate a quantity and died.

Howlers are troubled a great deal by a species of bot-fly. I have frequently counted a dozen or more of the large grubs in a single animal.

89-90. **Saimiri cassaquiarensis** and **S. ustus.** SQUIRREL MONKEYS.

These dainty little creatures were commonly met with in the huts of the natives, they being greatly esteemed as pets. In the forest I saw them in large troops, travelling rapidly high up in the trees. On account of their small size, they are difficult to see. In captivity they become very tame and confiding, and on account of their cleanliness and cunning, graceful ways, are very much sought for. They are very active, spending the entire day running back and forth, jumping after flies and mosquitoes, at catching which they are very adept, and exploring cracks and crevices for insects. I have kept them repeatedly, and found that they required water frequently during the day. They are very delicate and die if left out in the hot sun.

91. **Ateles longimembris.** LONG-LIMBED SPIDER MONKEY.

Spider monkeys were not rare in the vast forests of the upper Gy-Paraná, and I saw them occasionally, singly, in pairs and in small troops, in the trees, although one member of our party reports having found one on the ground. It lost no time in climbing a tree when it saw him. Usually they are travelling rather low down on the larger branches, swinging from one to the other rather than running and making the great leaps characteristic of other species. The speed with which they travel, at least all I saw, was not very great.

Occasionally they are found high up in the tallest trees, and will remain in a crotch quietly looking down upon the hunter. When wounded they utter a harsh cry. A large specimen, that had been wounded, hung suspended from a high branch by only the tail. As I waited for it to fall, it repeatedly reached for handfuls of leaves, which it plucked with one hand, and pressed to its breast, then dropped. The leaves fell near me and were found to be stained with blood. The other hand was clasped to its breast. As the shot from a second charge struck the creature, the shock caused it to throw out all four limbs, and something fell at my feet. It was a small young one, dead. On seeing me pick it up the old one immediately let go her hold and came crashing down after it. It is possible, even probable, that she had been compelled to let go on account of weakness; but she was by no means dead, and reached for me with her long slender arms, uttering deep, spiteful howls.

The spider monkey is hideous in appearance. The pinched, wrinkled face and fringe of bangs that extends straight over the eyes give it an aged, long-suffering appearance. The largest specimen I ever shot measured 1868 mm. from tip of fingers to tip of tail.

They are easily tamed and are interesting though grotesque pets.

92. **Aotus azaræ.** AZARA'S NIGHT MONKEY.

The clumps of heavy forest that dot the Paraguayan Chaco are the home of this species of night monkey. While nocturnal, the small family parties were still out feeding very early on dark cloudy mornings. The two individuals were taken from a family of four, consisting of adult male adult female, and two young male and female which were being carried by the female. The only other species of monkey observed in the same locality (Rio Negro, an affluent of the Pilcomayo) was the black howler.

93. **Aotus roberti.** NIGHT MONKEY.

Owing to its nocturnal habits this monkey is only rarely met with. Occasionally, however, it remains out to feed and play late into the day. While camping in the forest I have frequently heard troops of them gamboling in the treetops throughout the night, but they uttered no sound. Near San Augustin, in the Upper Magdalena, I found night monkeys spending the day in closely huddled bunches in the bamboos and dense brush along the rivers.

94. **Cacajao roosevelti.** WHITE-FACED MONKEY.

Two specimens were taken from a troop of fifteen or twenty that were feeding in the top of a tall tree, in a ravine near the Rio Commemoracão, and although they returned daily to the same tree, at about 4 P.M., it was impossible to ever again get within range of them. They travel through the trees rapidly, and make great jumps, at the same time giving vent to a short whistling whine. When feeding they are quiet. A large troop passing through the trees produces something of the effect of a strong wind.

This monkey is very rare. None of the natives on the Machado could recall having seen it before. All of the individuals of the large troop which I saw almost daily were of the same uniform black color; and the young female described below was also black.

Col. Rondon presented me with a small one that was given him by a Nhambiquara woman. The Indian's method of carrying it was to keep it on her head where it lay flat with arms and legs extending down. It looked exactly like a cap, for which we at first mistook it.

It was a tame and affectionate little creature, no larger than a half-grown squirrel. Its nose was bare and of a pink color. When caressed, it puckered its face in the most comical way, and shrieked with laughter. I have never seen another monkey of any species do this. Even when approached by a stranger it invariably laughed, and so ridiculous, yet amusing, was the expression of its face that no one failed to fall in love with it immediately. When I called it, even from a distance, it always answered with a prompt *cheep*, and continued answering as long as I called. Upon my approaching it, it tugged violently at its string, and was impatient to be played with. At night it grew impatient and restless. It called continuously and if I took it, it immediately snuggled about my neck and purred like a cat; when put back into its bed, which was a snug sheep-skin, it cried and wailed for some minutes, with a most pitiful inflection. Occasionally, during its restless moods at dusk, it would bite if taken by a stranger, but never hard enough to draw blood. If punished, it assumed the most startled and surprised expression, and sometimes ended with an attempt to laugh that never failed to make the person feel thoroughly ashamed of himself. It was very cleanly in habits. In picking up or taking things, it never used the thumb and fingers opposite to each other, as a person does, but the thumb always moved with the fingers so that the object was picked up awkwardly with the whole inner edge of the hand. I kept the little animal several months, feeding it upon rice, fruits, nuts, corn, bits of boiled meat or whatever we happened to have, and it thrived well. Reaching the Madeira River, I was given several other monkeys which required a part of my attention, although my first pet was always cared for first, and received the choicer and major portions of everything. Its disposition gradually changed, and it became sad and disconsolate. Finally, in Manãos other duties took up so much of my time that I had to turn all the animals over to an attendant. A week later I was told that my most highly prized pet was dead. It had refused food, and refused to leave the dark corner of the cage it had occupied. The keeper expressed the opinion, and I fully agree with it, that the little animal had grieved itself to death.

95. **Lagothrix cana.** BARRIGUDO MONKEY.

Of all the numerous species of South American monkeys which I have kept as pets, the woolly monkeys were undoubtedly the most amicable and the most interesting. I saw them frequently in the great lake-swamp on the Solimoens, feeding in the low berry bushes. Upon being approached they moved off rapidly. Where the great trees were some distance apart, they clambered to the end of the branches and then dropped to the cushion of shrubbery below, a distance of thirty feet or more, and scrambled on to the next tree. They are strongly built, with a prominent stomach, hence their local name of "barrigudo."

While working at Calama, a one-third grown specimen was given to me by a Bolivian woman. She was an invalid and could no longer care for it. Often it managed to free itself, when it would immediately enter her room, climb up the bed and, putting its arms around her neck, weep bitterly. It would also cry if spoken to in a soft, sympathetic tone, sniffling and wiping the tears with its hands.

I kept it in the same room with several other pets, including a kitten, a squirrel monkey and a small peccary, and the amount of abuse it endured from the three, without even losing its temper, is unbelievable. The kitten loved to jump at it and claw and bite its tail. If it slept, the peccary invariably came and, dropping on it, used it as a pillow. The squirrel monkey used it for its steed, and the hens stole his food; but it was always the same happy, leisurely little fellow. It was very proud of a necklace of large red beads that it wore constantly. If given a spoon or rubber ball it would play in the same spot a great length of time. It was very fond of rocking itself in a rocking chair, by standing upright, holding to the back with its hands and tail, and then "pumping." In eating, eggs and juicy fruits were held high above its head and the contents sucked out from below without spilling a drop.

They seem to be very hardy. Two that I brought to the States and which are now in the Bronx Park withstood the long trip well, and arrived in splendid condition.

The flesh of this species, known as "churuco" in Colombia, is said by native epicures to exceed that of any other kind in flavor.

The woolly monkeys [*Lagothrix lugens*] found in the vicinity of La Palma, near San Augustin, in the Upper Magdalena Valley seemed to attain a much larger development, with longer, thicker fur; this latter is not to be wondered at as the altitude is 5500 feet and the cold winds sweeping down from the nearby high mountains result in a very low temperature at night.

97. **Cebus azaræ.** AZARA'S CAPUCHIN MONKEY.

This is the species of monkey most often met with in captivity in the country it inhabits. The young are easily tamed and show affection toward their keeper, but they invariably set up a loud screeching and crying if approached by strangers. Its call, when undisturbed and feeding, is a quick series of bird-like chirps. When pursued it moves rapidly through the tree-tops, uttering a plaintive whine like that of a chained-up dog. It frequently attempts to hide in the dense foliage in the tree tops, and sits so quietly, that in spite of its large size it can not be seen. If one has the patience to wait, concealed in the undergrowth, the curiosity of the hiding animal may overcome its discretion, and it may move its head and be instantly revealed.

While hunting at Urucúm, I came upon a female and a two-thirds grown young that were feeding in different parts of a wild fig on the mountains. I saw the young first and wounded it with the first shot. It began screaming, and in a few leaps the mother reached its side, snatched it up and disappeared. She was not to be seen anywhere, so I fired the 'aux' into the tree-tops, knowing that the report would start her, which it did. It was necessary to do this a number of times. As each report rang out she dashed from one clump of cover to another; when the opportunity for a shot finally presented itself, both fell to the ground dead.

The habits of this species are disgusting and extremely obscene.

Callicebus lugens duida. MOUNT DUIDA MARMOSET.[1]

One of the first sounds that reached our ears after we had left the Rio Orinoco and were paddling slowly against the strong current of the Rio

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[1] [It seems desirable to record here some field notes by Mr. Miller, originally prepared for use in another connection, on a new subspecies of marmoset discovered by him at the base of Mount Duida, Venezuela. For the description of this new form see this Bulletin, Vol. XXXIII, p. 647, Dec. 14. 1914.— J. A. A.]

Cunucunumá, was a loud chorus of frantic, anguished little *oh's* coming from the tree-tops. The canoemen said the sound was produced by a "monito negro," and I was eager for a glimpse of the creatures; but it was not until some weeks later that I saw a troop of half a dozen moving rapidly through the trees. They travelled at a good rate of speed and made long leaps from the top of one tree into the branches of another. At frequent intervals during the early morning and late afternoon, they gave voice to their feelings in a series of fifteen to twenty *oh's* uttered in a high pitch, at first long drawn and plaintive, but ending short and jerky so that they sounded almost as if they were uttering one long wail while they covered the mouth with the hands and withdrew them alternately in rapid succession. The cry was very penetrating, all the individuals of a troop seemed to participate, and occasionally it could be heard at midday, but I do not recall that we ever heard it after sundown.

This species seemed to be very abundant. I saw them daily in pairs and in small troops of five or six. One pair which I collected had a one-third grown young which the male was carrying. At first the young was shy and frightened but did not attempt to bite. It ate greedily of rice, raisins, sugar, and wild fruits, preferring a small red berry of insipid taste (a species of fig) which grew abundantly on tall trees and upon which the adults feed regularly. After a few days it played about the tent cheerfully and could be picked up and carried about. Sometimes it assumed a most serious expression and uttered a few feeble little *oh's* in imitation of its wild brethren. A slight shot-wound, which a thorough examination had failed to reveal, became infected after about ten days and the little animal died. It was quite cheerful to the end and ate heartily a few hours before it died.

At about four in the afternoon these marmosets could be found in the trees near the river, but I could never find them actually drinking, although once I saw two low down in the branches.

When a troop was disturbed they made off in a body. If surprised suddenly with a shot, they scattered in all directions and sat in the tree-tops, concealed, some little distance away and uttered short whining grunts, evidently to prevent the individuals of the troop from straying too far and becoming permanently separated. The first time I heard this sound I mistook it for the low grunt of a herd of suspicious peccaries.

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Article XXXI.—ON THE STRUCTURE OF THE BRAIN-CASE IN CERTAIN LOWER PERMIAN TETRAPODS.

By D. M. S. Watson M.Sc., Lecturer in Vertebrate Palæontology, University College, University of London.

During the last ten years the work of E. C. Case and S. W. Williston has enormously extended our knowledge of the Lower Permian tetrapod fauna of Texas and New Mexico, making us acquainted with the whole skeleton of many forms. This extended knowledge shows that there is on the whole a great similarity in the skeletons of all these early types, so much so that the quite lengthy diagnoses of the "Orders Cotylosauria and Theromorpha" given by Williston in 1911 differ practically solely in the possession of a perforated temporal region of the skull in the latter forms.

During the last few years I have been able to examine the structure of the cranial cavity and brain-case generally in the following types of Permian and Triassic reptiles:—*Dicynodon, Endothiodon, Lystrosaurus, Kannemeyeria, Scymnognathus, Diademodon, Dimetrodon, Pariasaurus, Procolophon, Erythrosuchus, Belodon, Plateosaurus, Nothosaurus.* In very many more forms I have been able to see the general structure of the occipital region but not to examine the cranial cavity.

These studies have shown me that there is a great family resemblance between the cranial cavities of *Erythrosuchus, Belodon, Plateosaurus, Iguanodon* and Crocodiles, depending on the following features, and many more not listed:—

1. The separation of the inner ear from the brain cavity by bone.
2. The excessive narrowness of the cranial cavity between the ears.
3. The anteroposterior compression of the paroccipital process and the opening of the fenestra ovalis and the ductus fallopii on its ventral surface.
4. The enclosure of the anterior part of the brain by the bones usually but incorrectly called alisphenoids in crocodiles.

These characters are found in combination in no other groups of reptiles which I have been able to examine and seem to tie very closely together the Thecodonts, Deinosaurs and Crocodiles, groups which have long been recognized as allied. The fact that an extremely similar occipital region should characterize an obviously natural group of this kind, when considered in the light of the very considerable range of structure of this part found in others of the more modern reptiles, raises the hope that study of it would throw light on the interrelationships of the earlier reptiles. I purpose in this paper to examine certain early Tetrapods in this connection.

ERYOPS.

Occiput. The occiput of *Eryops* has been described by several authors; Branson, Broili, Broom, Case and v. Huene have given somewhat divergent accounts of it. By removing the matrix from the specimen in the American Museum (No. 4314e) which gave Dr. Broom much of his information, a task of no difficulty, I have been able to examine a perfectly preserved brain-case of this type. Study of it renders it certain that some of Dr. Broom's statements are not quite correct.

Basioccipital. The basioccipital is a small bone of spongy texture almost completely surrounded by other elements. As Dr. Broom has correctly represented it, it forms the lower part of the triple condylar surface supporting the exoccipital condyles above. The exoccipitals send in thin plates over its dorsal surface which apparently exclude it from participation in the formation of the cranial cavity.

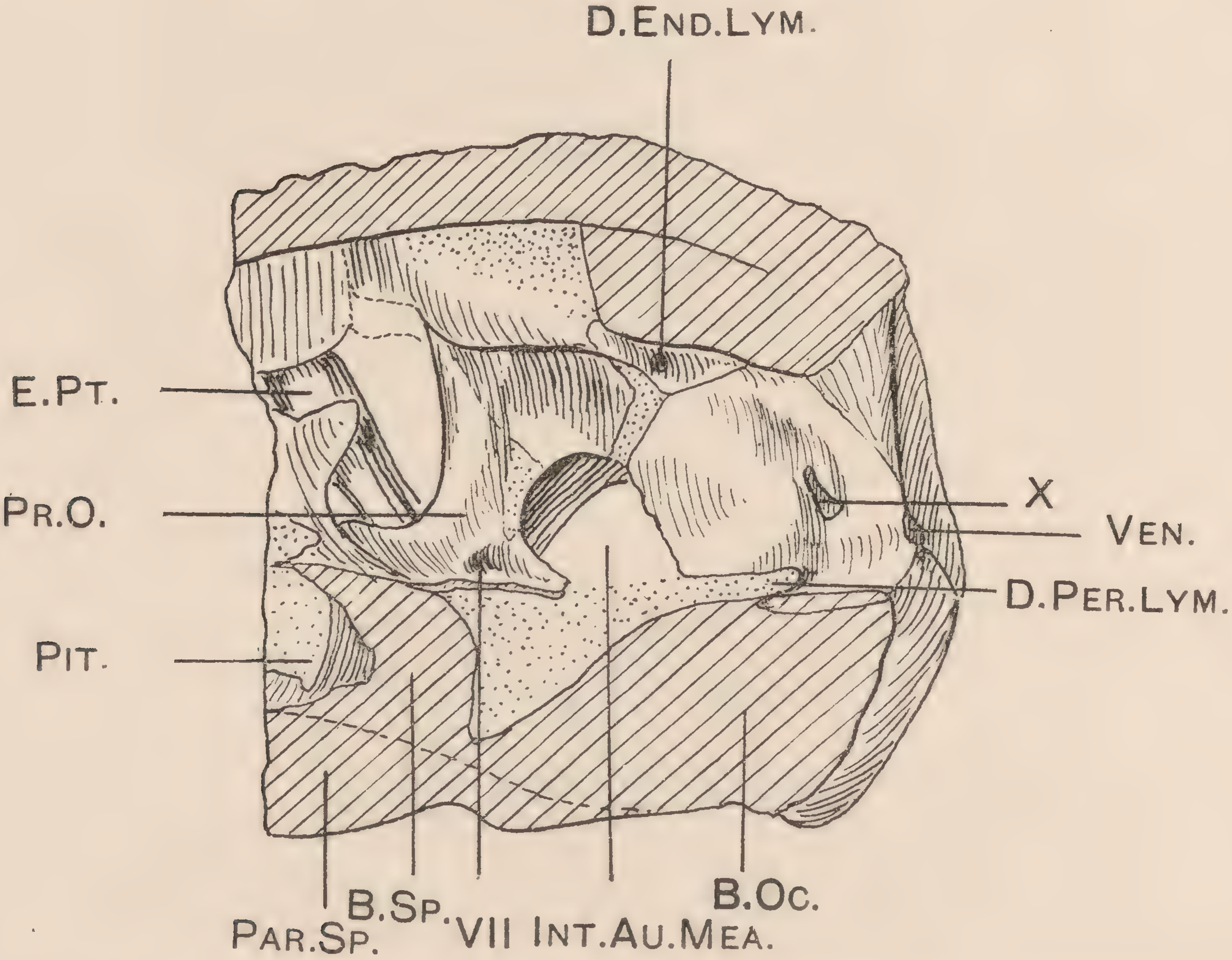

Fig. 1. Brain-case of *Eryops* sp. in median section. Amer. Mus. No. 4314e. × 1½.
B. Oc., basioccipital; *B. Sp.*, basisphenoid; *D. End. Lym.*, foramen for the ductus endolymphaticus; *D. Per. Lym.*, notch for ductus perilymphaticus; *E. Pt.*, epipterygoid; *Int. Au. Mea.*, internal auditory meatus; *Par. Sp.*, parasphenoid; *Pit.*, pituitary fossa; *Pr. O.*, proötic; *Ven.*, venous foramen; *VII* and *X*, exits of cranial nerve.

The lateral faces of the bone are in contact with the exoccipitals behind and the opisthotics in front. The anterior end of the bone thins rapidly and was obviously continued by cartilage.

The lower surface of the bone is exposed as a small triangular area just in front of the condyle; the lateral portions of the ventral surface are covered posteriorly by the exoccipitals and the remainder by the parasphenoid.

Basisphenoid. The basisphenoid is a small bone, which resembles the basioccipital in being only rather incompletely ossified. Posteriorly it nearly meets the basioccipital, its surface rising rapidly so as to leave a wide transverse groove of triangular section, filled during life by cartilage. This surface continues until it terminates in the thin dorsum sellæ. Much of the dorsal surface of the bone in this region is covered by the proötics. Further forward the upper surface is depressed to form the deep sella turcica, which is divided into two halves by a low rounded median ridge on its posterior face. Just behind the sella the basisphenoid is produced into the basipterygoid processes which articulate with the pterygoids.

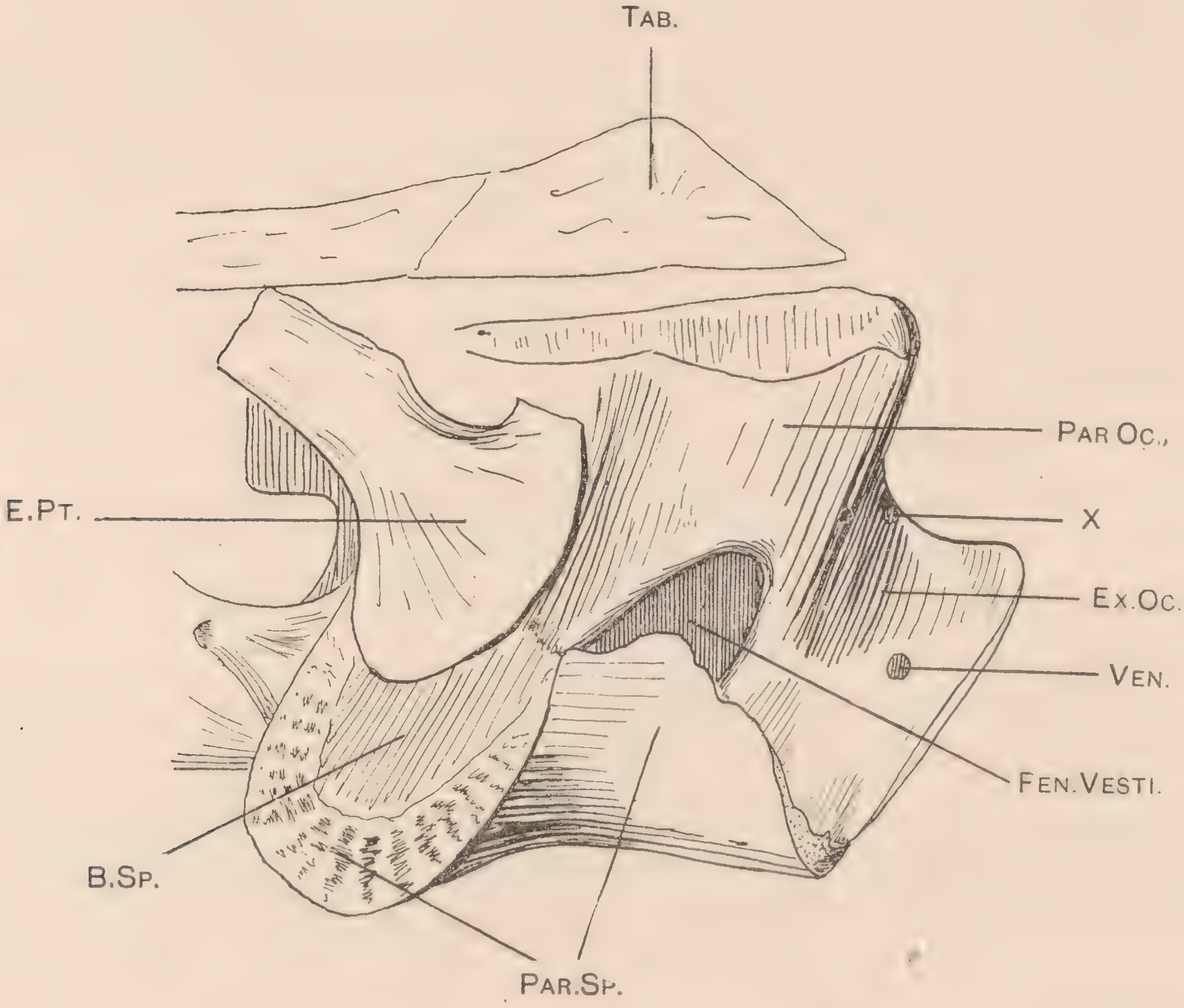

Fig. 2. Brain-case of *Eryops* sp. Lateral aspect. Amer. Mus. No. 4314a. × 1.
Reference letters as before with *Ex. Oc.*, exoccipital; *Fen. Vesti.*, fenestra vestibuli; *Par. Oc.*, paroccipital (opisthotic); *Tab.*, tabular.

The whole ventral surface of the basisphenoid is covered by the parasphenoid.

Exoccipital. The exoccipital is a remarkable bone. It forms the large exoccipital condyle on the posterior surface of the skull, in front of which the great mass of the bone lies; this mass is split, the upper portion forming the floor of the braincase and meeting or nearly meeting its fellow of the opposite side above the basioccipital. The lower part underlies the postero-lateral corner of the basioccipital, which is here nearly surrounded by it. Above the condyle the exoccipital is continued to the roof of the skull, as Dr. Broom has described it, being overlapped posteriorly by special lappets of the postparietals. It is uncertain whether these two bones really meet above the brain.

The anterior surface of the exoccipital is covered by the paroccipital, the suture being plainly visible on the outer surface and from within the ear cavity or rather the space formerly filled with cartilage in connection with it, although not on the endocranial surface.

On the posterior surface of the exoccipital above the condyle and only just lateral to the foramen magnum is a small foramen which as it seems to be sometimes absent can only be for a blood-vessel. On the same level as this but further from the middle line is another somewhat larger foramen, through which the suture between the exoccipital and paroccipital seems invariably to pass, although it lies almost wholly in the exoccipital. On the lateral surface of the condylar portion of the exoccipital is another very small and inconstant foramen.

Behind the paroccipital on the endocranial surface four or fewer foramina leave the brain cavity; one of these presumably lies in the suture between the paroccipital and exoccipital and is constant; it leads to the outer of the two foramina on the occipital surface above the exoccipital condyle.

The other three foramina lie one above the above described opening, this being inconstant, another and very small one below, and the third only just within the foramen magnum; all pass merely into the body of the bone and must be for blood-vessels.

Paroccipital. The paroccipital is a large bone closely united with the exoccipital; it has a large process extending out beyond the exoccipital, when viewed from behind, to articulate with the tabulare in a manner Broom has already described. This process passes down into a part of the bone which lies immediately in front of the lowest (condylar) part of the exoccipital, which terminates anteriorly in a smoothly rounded border of the large fenestra ovale. On the inner aspect the suture separating the paroccipital and exoccipital is not visible but consideration of the position of the semicircular canals and the inner opening of the foramen, the external opening of which lies in the suture, renders it possible to fix its position, with some certainty. The paroccipital on its endocranial face is a large bone, the visible portion being a very thin plate of bone which divides the posterior part of the vestibular cavity from that for the brain. This sheet passes backward into a mass of spongy bone which lies in front of the exoccipital and passes outwards into the paroccipital process and to the fenestra ovale. Its lower border is articulated with the basioccipital and its anterior face forming the posterior wall of the vestibular cavity is perforated by a hole which leads directly into the posterior ends of the horizontal and posterior vertical semicircular canals, which are quite distinctly shown although their walls are not composed of very compact bone.

The vestibular cavity is open to the brain through a special notch between the plate of bone which forms most of the endocranial exposure of the paroccipital and that process of the basisphenoid which floors the cranial cavity. The anterior edge of the paroccipital on the endocranial surface is separated by an open suture from the proötic and by a somewhat less distinct, though I think certain one, from a supraoccipital; below the suture with the proötic it forms the posterior margin of the large internal auditory meatus, from the posterior lower corner of which the special slit already described passes backwards.

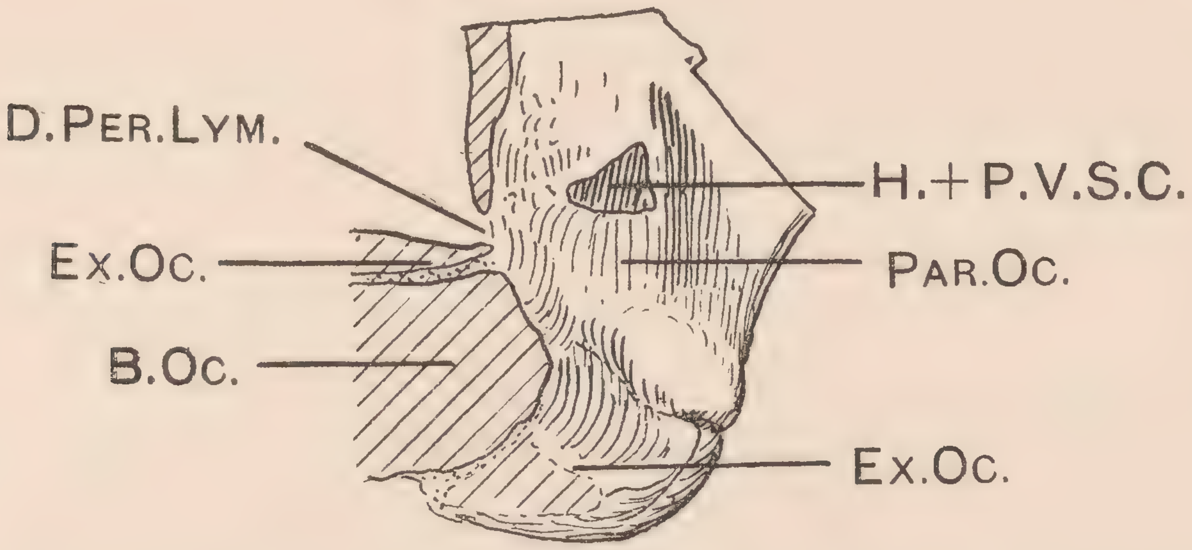

Fig. 3. Brain-case of *Eryops*, same specimen as Fig. 1, Amer. Mus. No. 4314e, left side, cut vertically through the vestibule whose hinder wall is shown and the Fenestra ovale. × 1½.

Reference letters as before with *H. + P. V. S. C.*, opening leading to the posterior ends of the horizontal and posterior vertical semicircular canals.

Proötic. The proötic is a large bone applied to the front face of the paroccipital. Although the suture on the paroccipital process is not visible its continuation within the fenestra ovalis renders it certain that the whole anterior part of the process is proötic. Below the two bones are separated by the large fenestra ovalis, above which the proötic is continued to articulate with the skull, mostly with the parietal but probably in part also with the "supratemporal." This portion of the proötic is pierced by a venous foramen passing upwards. Internally the proötic is produced inwards and forwards by a process which overhangs the incisura proötici and extends forwards to meet what is apparently the posterior end of the sphenethmoid.

Below and in front of the fenestra ovalis the proötic is in contact with the basipterygoid region of the basisphenoid from which it is not separated by suture externally. On the inner surface the proötic has a distinct suture with the supraoccipital and with the paroccipital, the three bones meeting in the familiar triradiate suture, and more ventrally forms the anterior border of the large internal auditory meatus, medially and anteriorly to which it expands into a horizontal sheet forming much of the floor of the brain cavity. This floor just internal to the internal auditory meatus is depressed into a shallow pit from the anterior part of which the aquæductus fallopii for the VIIth nerve opens. The flooring portion of the proötic extends forward in advance of the incisura proötici overlapping the lateral portion of the dorsum sellæ and forming a distinct processus anterior inferior from which rises an extremely delicate plate forming a wall to the brain cavity and extending up almost to the posterior end of the sphenethmoid so as to convert the incisura prootici into a foramen. The external opening of the "aquæductus fallopii" is not known but it is seen in sections to pass straight down through the bone.

The portion of the inner ear which lies within the proötic has not been cleared but something is seen of its structure in sections.

Supraoccipital. The supraoccipital is a small bone apparently continuous across the middle line and with the exoccipitals. It unites with the proötic and paroccipital of either side in a triradiate suture and obviously, from the known structure of the paroccipital and proötic, must contain the upper parts of the vertical semicircular canals, and is pierced on each side by a very small foramen for the ductus endolymphaticus.

Parasphenoid. The parasphenoid is a very large bone, with a long anterior stem, a channel, the upper surface of which receives the sphenethmoid. Posteriorly the bone expands, covering the whole lower surface of the basisphenoid and much of that of the basioccipital. It extends out so as to sheath the lower surface of the basipterygoid processes, having sutures with the pterygoids. Behind this it reaches up by special flanges outside the basisphenoid to form the lower margin of the fenestra ovalis. Its extreme postero-lateral corners are drawn out into low muscular processes over the meeting place of the paroccipital, exoccipital and basioccipital; these are typical tubera basisphenoidales.

On the lower surface of the parasphenoid passing round from the back of the basipterygoid process is a deep groove which leads to a foramen, plunging into the rostral portion of the bone and apparently (though not certainly) opening on its dorsal surface in advance of the sella turcica.

Another foramen enters the upper surface of the basipterygoid from near the front and a third enters its front face.

Stapes. A very well preserved stapes is present in position in a fragment of an *Eryops* skull (Amer. Mus. No. 4200). It is a rather massive bone considerably curved dorso-ventrally but straight in the other plane. At the outer end it is about 8 mm. deep and through anteroposterior compression about 4 mm. thick. Proximally the bone deepens and is pierced anteroposteriorly by a rather large foramen, immediately medial to which it separates into two stout branches, the upper being much the larger and lying in the fenestra ovalis. The lower is much smaller and is quite widely separated by a broad and shallow notch from the upper; it is a little difficult to see how it could have articulated with anything and it may be a muscle insertion.

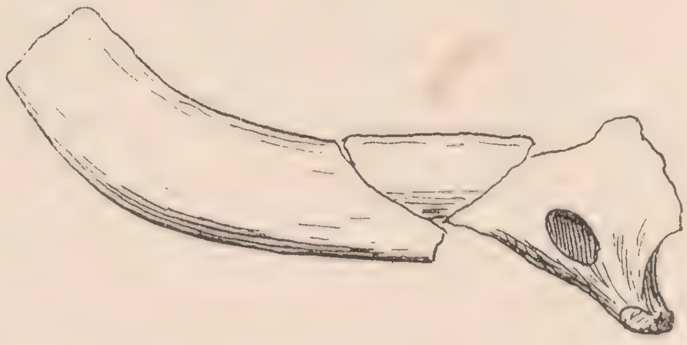

Fig. 4. Stapes of *Eryops*. Amer. Mus. No. 4200. × 1. Accidentally broken into three pieces.

Discussion of the Eryops Brain-case. The position and to some extent the structure of the inner ear being known there can be no doubt that the internal auditory meatus and fenestra vestibuli (seu ovalis) are correctly identified; the occurrence of a stapes still in situ in the latter adds further proof if any should be needed. It is apparently to the fenestra vestibuli that Broom refers as "a large oval foramen for the IXth, Xth, and XIth nerves" (p. 587). It is therefore necessary to seek a new opening for the vagus. The peculiar notch running back from the internal auditory meatus reminds one of the internal opening of the jugular foramen in certain types; as, however, it runs directly into the inner ear and there is no opening out of that cavity on the external surface except the fenestra vestibuli, it cannot be for any nerve and it appears probable to me that it transmitted the ductus perilymphaticus to the cranial cavity.

The only opening behind the ear which leads from the cranial cavity to the outside is that foramen whose outer opening though lying almost entirely in the exoccipital is cut by the suture between that bone and the paroccipital in all cases. This foramen must therefore be for the vagus which always leaves between the exoccipital and the paroccipital. As there is no other foramen further back which pierces the exoccipital there is no evidence in this form of the presence of a hypoglossal nerve.

The other foramina, that for the ductus endolymphaticus in the supraoccipital and for the VIIth nerve in the proötic, are identified with certainty.

The outer opening of the facial nerve has not yet been seen, and I am inclined to consider that it lies above the basipterygoid process, the nerve immediately after its exit entering that process and passing through it to leave by the foramen on its front face; this point, however, must remain subject to very grave doubts. What the grooves round the lower surface of the basipterygoid processes are for if they be not for the internal carotids I do not know, but they seem to reach the dorsal surface of the basis cranii somewhat forward for those vessels.

SEYMOURIA.

The brain-case of *Seymouria* is represented solely by that of the badly preserved type specimen of *Conodectes favosus* Cope (Amer. Mus. No. 4342). This specimen shows very little of the exoccipital, nothing of the basioccipital and only the lateral border of the basisphenoid.

Exoccipital. The extreme dorsal tip of the exoccipital ends in a rounded surface, presumably formerly continued by cartilage. This surface lies immediately below the ventral border of a lappet formed almost equally by the postparietal and tabular. This scrap of exoccipital is separated from the paroccipital by a large groove, the upper part of the foramen jugulare.

Paroccipital. This is a large bone stretching out to the tabular which sends a special process down its posterior and upper surface.

Proximally the paroccipital is separated from the proötic by the apparently large fenestra ovalis but distally these two bones meet in suture.

Proötic. The proötic is a large bone which covers the front face of the paroccipital and stretches at its lateral corner up to the skull roof where it articulates with the "supratemporal." The flat front face of the bone is pierced by a large venous foramen and its anterior border is continuous with that flange of the basisphenoid which passes back to form the tuber basisphenoidale.

Endocranial cavity. The endocranial cavity is extremely badly preserved, but shows that the internal auditory meatus was very large and that there was something in the nature of a supraoccipital.

Sphenethmoid. There is a large sphenethmoid which has not been sufficiently cleared for description.

DIADECTES.

The brain-case of *Diadectes* has been described by Cope and v. Huene, both of whom have figured a "brain cast" now in the American Museum (No. 4843). v. Huene's account of the external surface of the brain-case is fairly accurate but the brain cast taken from a specimen in which the whole basis cranii had been lost before burial and a good deal of the proötic removed since is extremely misleading. The following account is drawn up mainly from No. 4843 in the American Museum which is uncrushed and well preserved and has been very completely cleared of matrix both inside and out by the author. All the other material in the Museum has been used for comparison and the whole gives an almost complete knowledge of the region under discussion.

Basi- and Exoccipitals. The basi- and exoccipitals are fused and no specimen shows a clear suture between them. The three bones form an almost circular condyle which is generally flat but has a somewhat steep walled notochordal pit towards the upper edge. The basioccipital extends forward, most of its lower surface being covered by the basisphenoid or more probably by a parasphenoid indistinguishably fused with that bone.

On the lateral face near the back is a facet for the opisthotic behind which lies the groove which forms the lower part of the foramen jugulare. A good deal of the dorsal surface of the basioccipital posteriorly is covered by the exoccipitals which may indeed meet below the brain. The exoccipitals bear strong upstanding processes which form the walls of the cranial cavity and unite with the opisthotic by a small face in front of the jugular foramen and by a very large flat facet with the opisthotic and supraoccipital above. The side wall of the exoccipital just at its base is pierced by a single foramen for the XIIth nerve and further forward a foramen enters the bone on the floor of the brain cavity and has no visible exit.

Basisphenoid. The basisphenoid of *Diadectes* is a large and very characteristic bone. Its body lies in front of the basioccipital, and it overlaps the lower surface of that bone, there being no definite tubera at the junction. The lower surface in this region has a median ridge and powerful muscular insertions for the recti capitis on each side of it. Further laterally it is provided with two processes which form the lower border of the fenestra vestibuli. These muscle insertions are shaded by two large flat processes forming the lateral borders of the bone and extending down so as to form pockets in which the insertions of the muscles lie. These processes are of very varied sizes; in No. 4239 (an old individual) they are comparatively small, whilst in No. 4843 (which is younger) they are very large, meeting in the middle line and extending back about to the basisphenoid-basioccipital suture. The pocket formed by these flaps gradually reduces in size as it is traced forward until it ends in a single minute foramen which cannot possibly be for the carotid because it does not pass through the bone (No. 4378). In advance of these pockets the bone is rather narrow and bears the short basipterygoid processes which have a distinct groove for the entocarotid on the lower surface. In some specimens, but as Case has already stated not in all, a small foramen opens into the lower surface of the basisphenoid between the processi basipterygoidei.

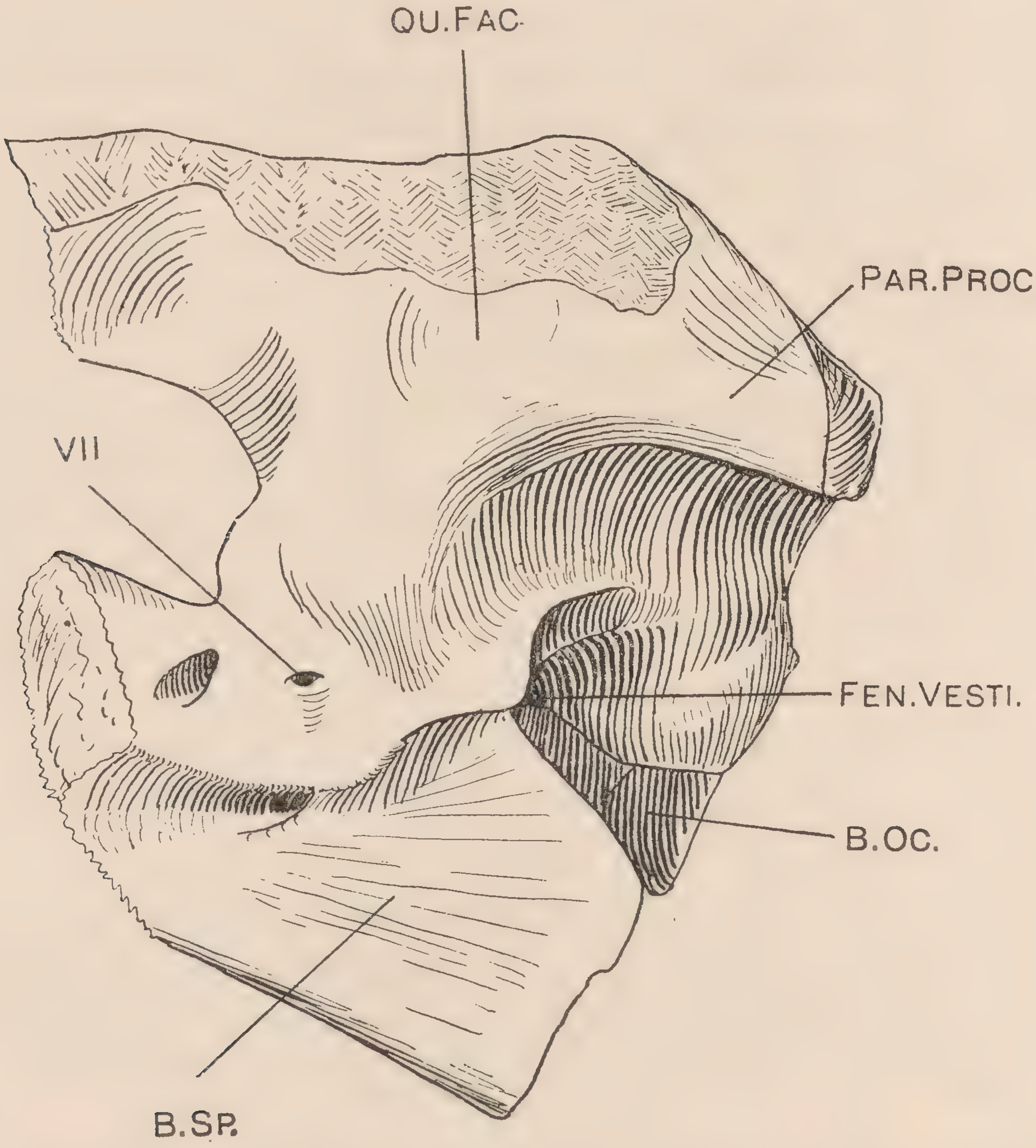

Fig. 5. Posterior part of the brain-case of *Diadectes*. Amer. Mus. No. 4843. Lateral aspect. × 1.

Reference letters as before with *Par. Proc.*, paroccipital process; *Qu. Fac.*, facet with which the mass of bone surrounding the top of the quadrate articulates.

The front end of the basisphenoid is continued by a long and powerful parasphenoidal rostrum above which is the sella turcica. This is a large and deep cavity tunnelling backwards horizontally into the bone and overhung by a rather massive dorsum sellæ. The posterior end of the sella is divided by a median septum and ends blindly. On the lateral surface somewhat behind the level of the posterior end of the sella a large foramen opens forward; this leads from a cavity which in the bony skull is continuous with that for the vestibule and its meaning is quite obscure.

Otic capsule. The bones of the otic capsule are indistinguishably fused even in quite young individuals, but the regions can be easily distinguished.

Paroccipital. The paroccipital (opisthotic) has two facets, a small lower and a large upper one for the exoccipital and just meets the basioccipital. Its front face is in contact with the proötic, the two together forming a very short but massive paroccipital process which is covered dorsally by the overlapping tabular and which seems to have a small contact with the squamosal distally. No. 4378 seems to show that the "supratemporal" does not meet the paroccipital process. The fenestra vestibuli lies on the snterior face of the process somewhat anterior to its distal end and only just above the lower border.

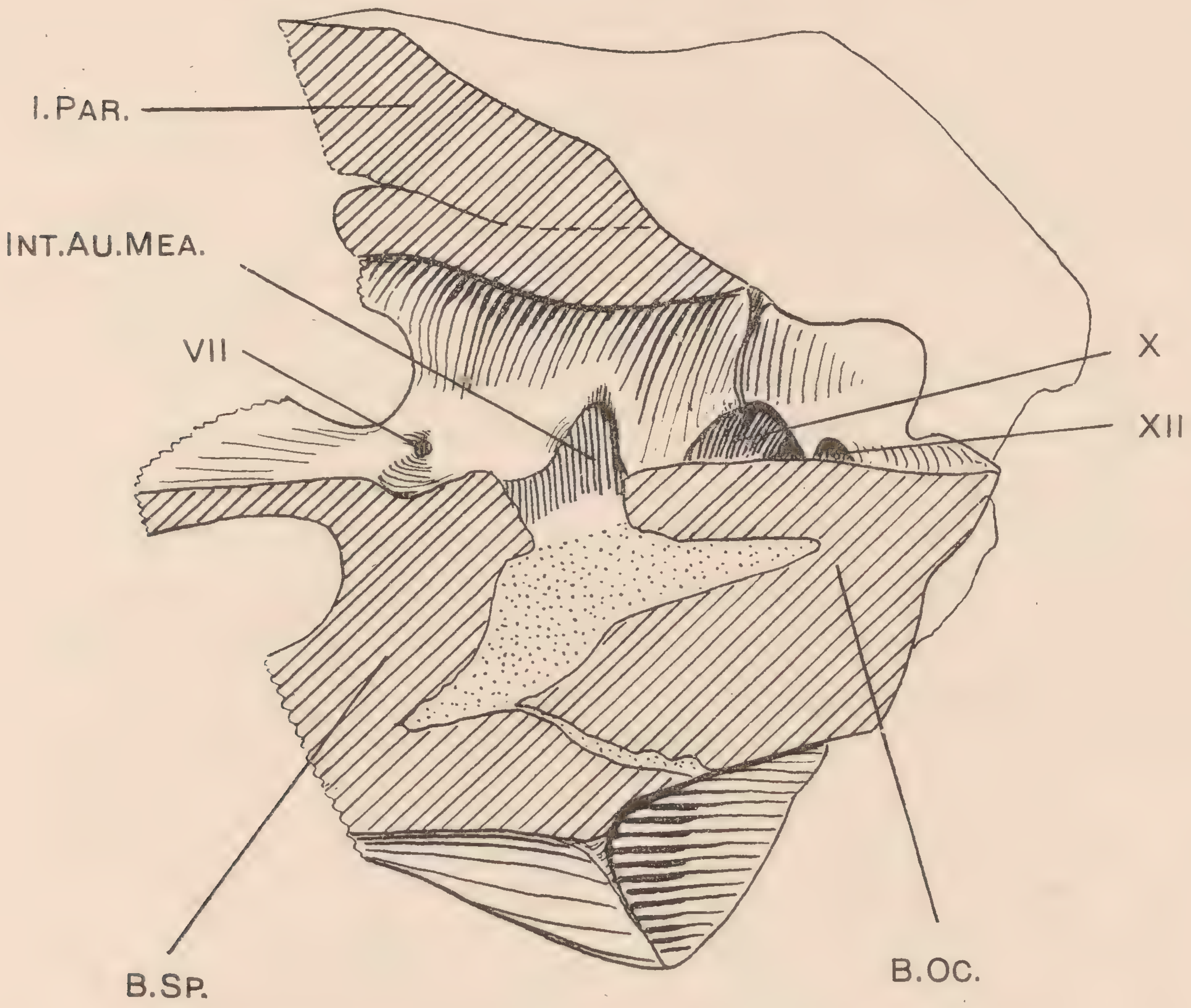

Fig. 6. Posterior part of the brain-case of *Diadectes* in median section. Amer. Mus. No. 4843. × 1.

Reference letters as before with *I. Par.*, interparietal.

The opisthotic can have only a very small exposure on the endocranial surface, mainly represented by the triangular area and narrow ridge between the very large internal auditory meatus and the large foramen jugulare. There is a distinct notch in this ridge which represents the fenestra rotunda.

Proötic. The proötic forms the anterior part of the fenestra vestibuli from which its long suture with the basisphenoid runs forward. Its outer surface has a shallow depression just over the paroccipital process in the region where it is fused with the parietal, which seems to have abutted against the mass of bones sheathing the head of the quadrate. The contact with the roof of the skull is a prolonged one and in some specimens at any rate a special process runs laterally to articulate with the lower surface of the "supratemporal." On the inner surface the proötic forms the anterior margin of the internal auditory meatus from which a marked short groove runs forward at the anterior end of which lies the foramen pro nervo faciali. There is a large deep incisura proötici.

Supraoccipital. The supraoccipital cannot be clearly distinguished from the other bones but, judging from the position of the vertical semicircular canals whose upper parts always lie within it, must form a good deal of the roof of the brain cavity running forward from the top of the foramen magnum nearly to the parietals. It is not pierced by any foramina.

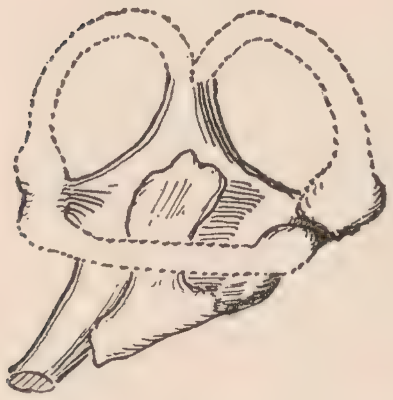

Fig. 7. The bony labyrinth of *Diadectes*. Amer. Mus. No. 4843. × 1.

Inner ear. The inner ear cavity is in very wide communication with the brain cavity through the large internal auditory meatus. There is a large triangular vestibular cavity from which three processes lead to the roots of the semicircular canals. The anterior has the forward end of the horizontal canal cleaving, and then runs forwards before turning upwards to the anterior semicircular canal. The posterior is a rather narrow and lengthy process whose splitting is only just indicated. The upper is short and divides into two equal branches. The actual canals visible in No. 4441 are slender and pass round as segments of circles in a very simple way.

On the outer side of the vestibular cavity is a long tube which leads to the fenestra vestibuli. This tube is very remarkable because an oval foramen opening into its dorsal surface leads into a very large and irregular cavity lying within the semicircular canals. This feature is so far as I know quite unique, and no explanation of it suggests itself.

The inner ear is in connection with a large recess lying between the dorsal surface of basisphenoid and the proötic, from which a foramen opens forward to the exterior of the basisphenoid.

The anterior part of the brain is surrounded by a bone which rests on the dorsal surface of the parasphenoid and, except that it is not continuous above the brain, has all the appearance of the sphenethmoid of *Pariasaurus* or *Eryops*.

It is not possible to be certain of the number and position of the foramina leading through this bone.

Discussion of the Diadectid Brain-case. All the nerve exits of *Diadectes* are identified without any difficulty since they agree with the ordinary reptilian arrangement in general plan. The question of the identification of the vascular foramina is, however, at present insoluble, as it seems certain that the blood supply of the head differed considerably from that of known living reptiles and indeed from that of fossil reptiles also.

The vein which in some individuals pierces the proötic high up is paralleled in many early reptiles and perhaps represents an early condition of a branch of the vena capitis lateralis.

CAPTORHINUS.

No account of the brain-case of a Captorhinid which is at all detailed has been published, but Broili, Williston and Branson have given short accounts, mainly of its occipital surface.

The material at my disposal (Amer. Mus. No. 4315) is not of a very satisfactory character, but does enable me to add a few facts to those already recorded.

Captorhinus and *Labidosaurus* differ in details but are essentially similar and the followng description founded mainly on *Captorhinus* is completed from *Labidosaurus*, portions so introduced being specially mentioned.

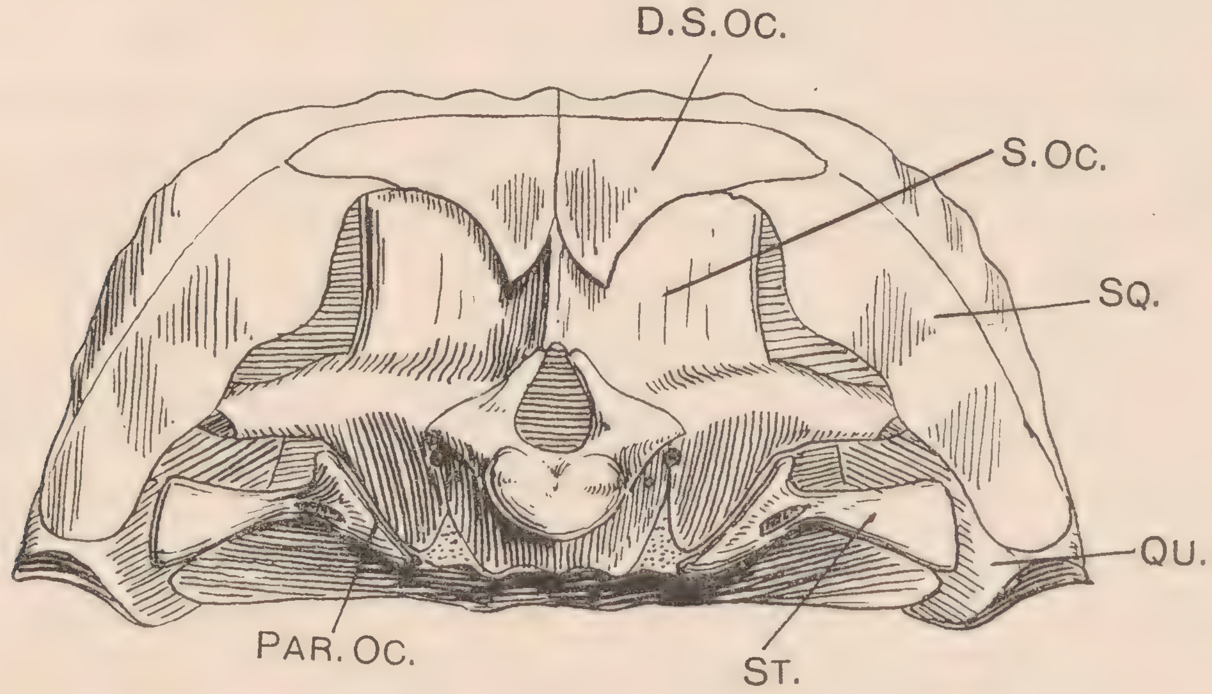

Fig. 8. Occipital view of skull of *Captorhinus* sp. Amer. Mus. No. 4315. × 1½.
Reference letters as before with *D. S. Oc.*, dermosupraoccipital (postparietal); *Qu.*, quadrate; *S. Oc.*, supraoccipital; *Sq.*, squamosal; *St.*, stapes.

Basioccipital and Exoccipital. The basi- and exoccipitals are fused but the suture separating them is seen indistinctly in No. 4876, *Labidosaurus*.

The condyle is large, rounded and very markedly tripartite, the upper half of it being formed by the exoccipitals which are separated by a deep notochordal pit, but meet in the middle line to form the floor of the brain-case. The basioccipital is a somewhat short bone and its lower surface towards the front is produced into distinct processes for articulation with the tubera basisphenoidales. These are much more marked in *Labidosaurus* than in *Captorhinus*. The lateral borders of the joint basi- and exoccipitals form an almost flat surface terminated above by the notch which forms the posterior border of the foramen jugulare, above the opening the exoccipital is produced as a small angular process. The exoccipital ends dorsally in a large flat surface for articulation with the supraoccipital and paroccipital. The exoccipital is pierced at the level of the base of the brain cavity by a small foramen for the XIIth nerve.

Basisphenoid. The basisphenoid is a large bone articulating with the basioccipital behind and continued in front by a strong parasphenoidal rostrum. The lower surface of the bone bears a pair of strong ridges which in front form the bottom of the basipterygoid processes and posteriorly overlap processes on the basioccipital to form the tubera basisphenoidales; the outer edge of the bone in the latter region is continued upwards by a somewhat faintly distinct border which forms some of the rim of the fenestra vestibuli.

Paroccipital. The paroccipital is a comparatively small bone which articulates with the exoccipital and basioccipital behind, with the supraoccipital above and with the proötic in front.

The paroccipital process is a short and rather slender rod, the paroccipital part of it being grooved on its anterior and lower edge. Below the process the paroccipital is continued downwards as a large area of bone lying in contact with and immediately outside of the tuber of the basioccipital. The lateral margin of this region of the bone forms the posterior border of the fenestra vestibuli.

Proötic. The proötic is not well known; it is a comparatively small bone covering the front face of the paroccipital and extending out into the paroccipital process. It forms the front border of the fenestra vestibuli below which it articulates with the basisphenoid. Dorsally it articulates with the supraoccipital and ends in a notch for a venous exit from the brain cavity. The anterior border has a shallow incisura proötici.

It is specially to be noted that the proötic does not nearly reach up to the roof of the skull.

Supraoccipital. The supraoccipital forms the upper part of the foramen magnum and articulates by a small surface with the exoccipitals and by large ones with the proötics and opisthotics. Above its contact with these bones it widens and is converted into an anteroposteriorly flattened plate with a slender ridge running down to the top of the foramen magnum behind and a much more powerful one in front. The lower ends of the postparietals overlap the posterior surface of the bone being separated by this ridge ventrally.

The opening for the anterior and posterior vertical semicircular canals are very plainly shown in No. 4705, *Labidosaurus*. The two genera are very similar in this regard.

I have been unable to obtain a satisfactory preparation of the cranial cavity which is, however, very high and short behind the incisura proötici.

Stapes. The stapes is a large bone having an enormous foot plate which articulates with the paroccipital, basisphenoid and proötic round the border of the fenestra vestibuli. Immediately distal to the foot the stapes is perforated by a large foramen which runs from below and behind, upwards and forwards. Beyond this region the bone has a narrow shaft which expands to a head lying in a special groove in the quadrate.

The brain-case of this form is still so incompletely known that it does not call for any detailed discussion in this place.

THEROPLEURA.

The brain-case of a member of this genus is very well shown in Cope's type specimen of "*Diopeus leptocephalus*" (Amer. Mus. No. 4155) which is excellently preserved, the bones being disarticulated, largely free from matrix and uncrushed.

The basi- and exoccipitals are fused as are the paroccipitals, proötics and supraoccipitals, but the basisphenoid, postparietals and tabulars are disarticulated.

Basi- and Exoccipitals. The basioccipital and exoccipitals of *Theropleura* are fused but the sutures separating them are visible through most of their course. The three bones form a tripartite condyle of which the lower three-quarters are provided by the basioccipital which is a rounded knob. The exoccipital regions of the condyle are separated by a deep pit and lie in a level anterior to that of the basioccipital. The basioccipital is a short bone whose anterior lower margin is articulated with the basisphenoid presumably through a pad of articular cartilage. The lower surface is produced into long and strong processes which with the corresponding flange of the basisphenoid form the tubera, the outer face of this process being a distinct articular facet for the stapes.

The exoccipitals cover the whole dorsal surface of the basioccipital, meeting in the middle line. From this region in each bone a strong process rises which forms the side of the foramen magnum and is pierced by a single foramen for the twelfth nerve. This process terminates dorsally in a large nearly flat articular face directed upwards, outwards and forwards which joins the supraoccipital and paroccipital. The anterior face of this process has a small notch which forms the back of the foramen jugulare.

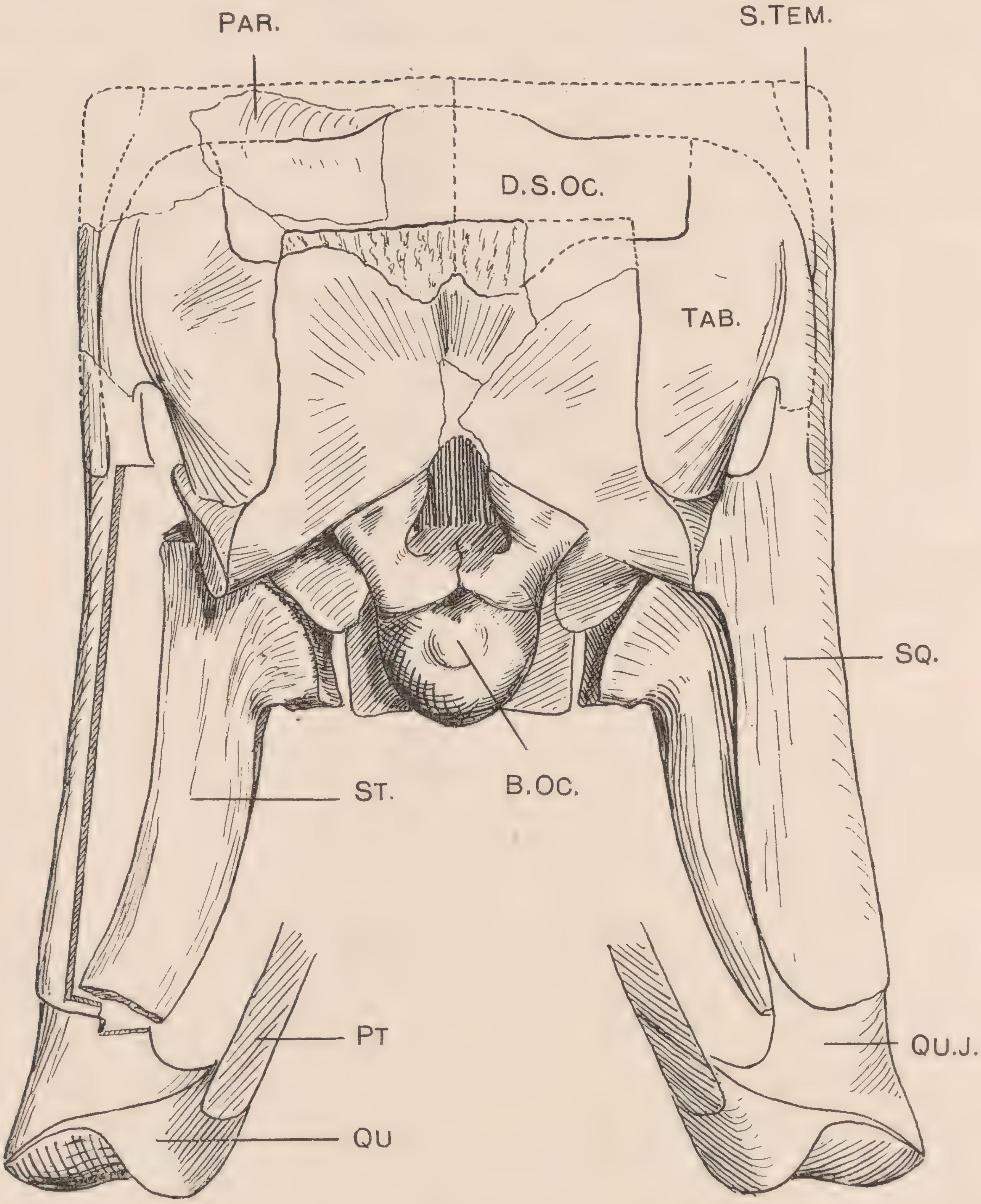

Fig. 9. Occipital view of the type skull of *Diopeus leptocephalus* Cope. Amer. Mus. No. 4155. × $\frac{2}{3}$. Each side restored from the other. Regions in dotted outlines hypothetical.

Reference letters as before with *D. S. Oc.*, dermosupraoccipital = postparietal; *Par.*, parietal; *Pt.*, pterygoid; *Qu.*, quadrate; *Qu. J.*, quadratojugal; *S. Tem.*, supratemporal; *Sq.*, squamosal; *St.*, stapes.

The lateral surface of the exoccipital has a facet continuous with one on the upper end of the process of the basioccipital which helps to form the tubera, with which the lower end of the paroccipital articulates. In front of the facet there is a deep depressed area on the lateral aspect of the bone which forms the inner wall of the vestibular cavity.

Basisphenoid. The basisphenoid articulates posteriorly with the basioccipital, being produced into powerful processes which join with the corresponding parts of the basioccipital to form the tubera. Lateral to the articulation the posterior margin of the basisphenoid spreads out into a wing which forms the front border of the fenestra vestibuli, and dorsally articulates with the proötic. This process and wing is continued forwards by a ridge on the lower surface of the bone which terminates in the powerful downwardly produced processus basipterygoideus. From there the bone is continued forwards by a long straight parasphenoidal rostrum.

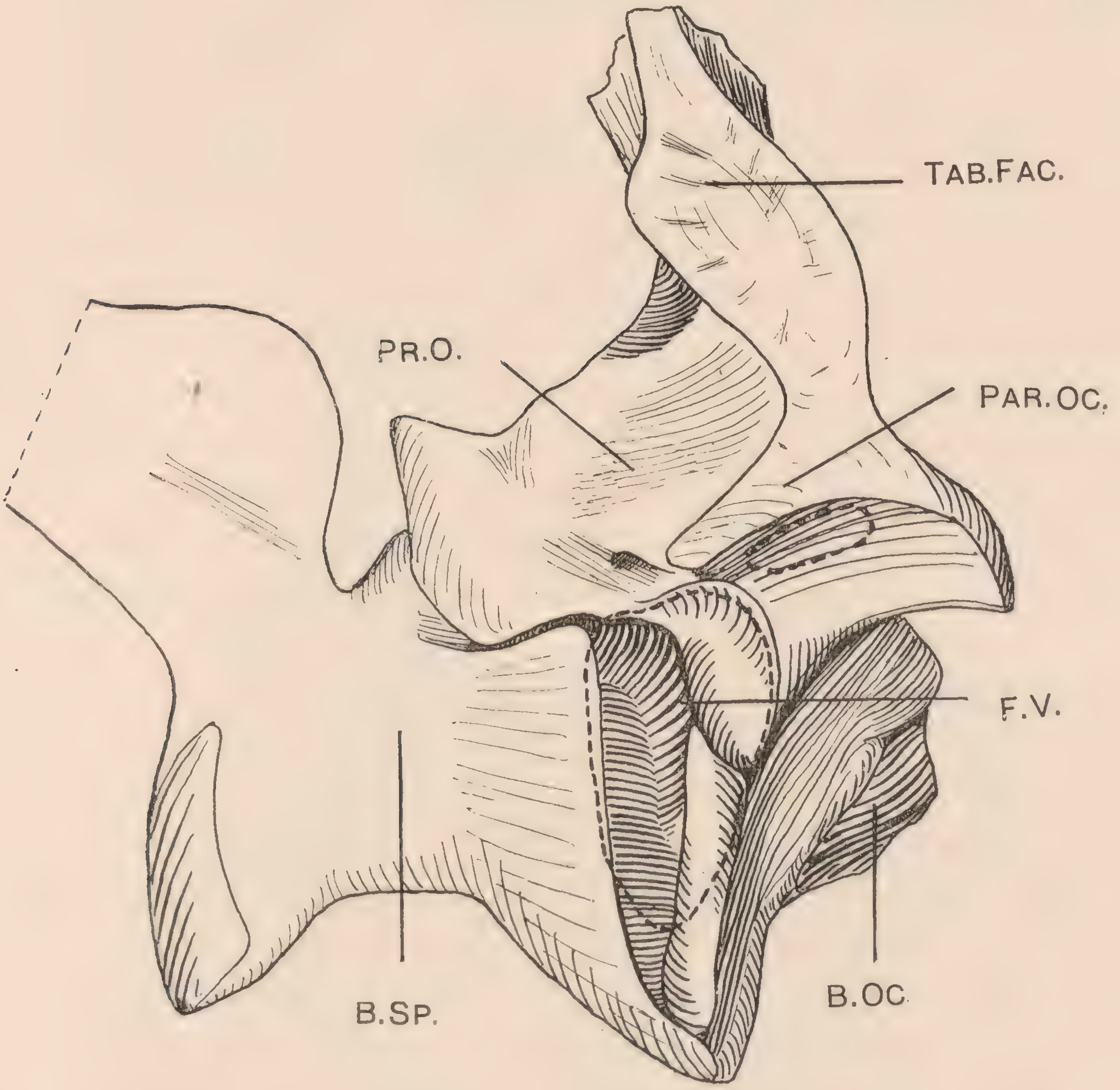

Fig. 10. Brain-case of the type specimen of *Diopeus leptocephalus* Cope. Amer. Mus. No. 4155. × 1. Lateral aspect.

Reference letters as before with *F. V.*, fenestra vestibuli; *Tab. Fac.*, tabular facet on the supraoccipital.

The sella turcica lies immediately above the basipterygoid processes, forming a deep pit whose lateral walls articulate with the proötic dorsally.

Between the posterior end of these walls and the wing which articulates with the proötic posteriorly is a small notch which may be the lower border of a foramen similar to that which pierces the side of the basisphenoid in *Diadectes*. There is no ossified dorsum sellæ on this specimen.

Although the proötic, opisthotic and supraoccipital are fused it is easy to distinguish approximately the various regions.

The paroccipital articulates with the exoccipital by two facets separated by the notch which forms the front border of the foramen jugulare. Immediately lateral to this notch the bone forms an extremely short paroccipital process which articulates with the squamosal. The ridge which forms the lower border of this process is continued inwards and is terminated

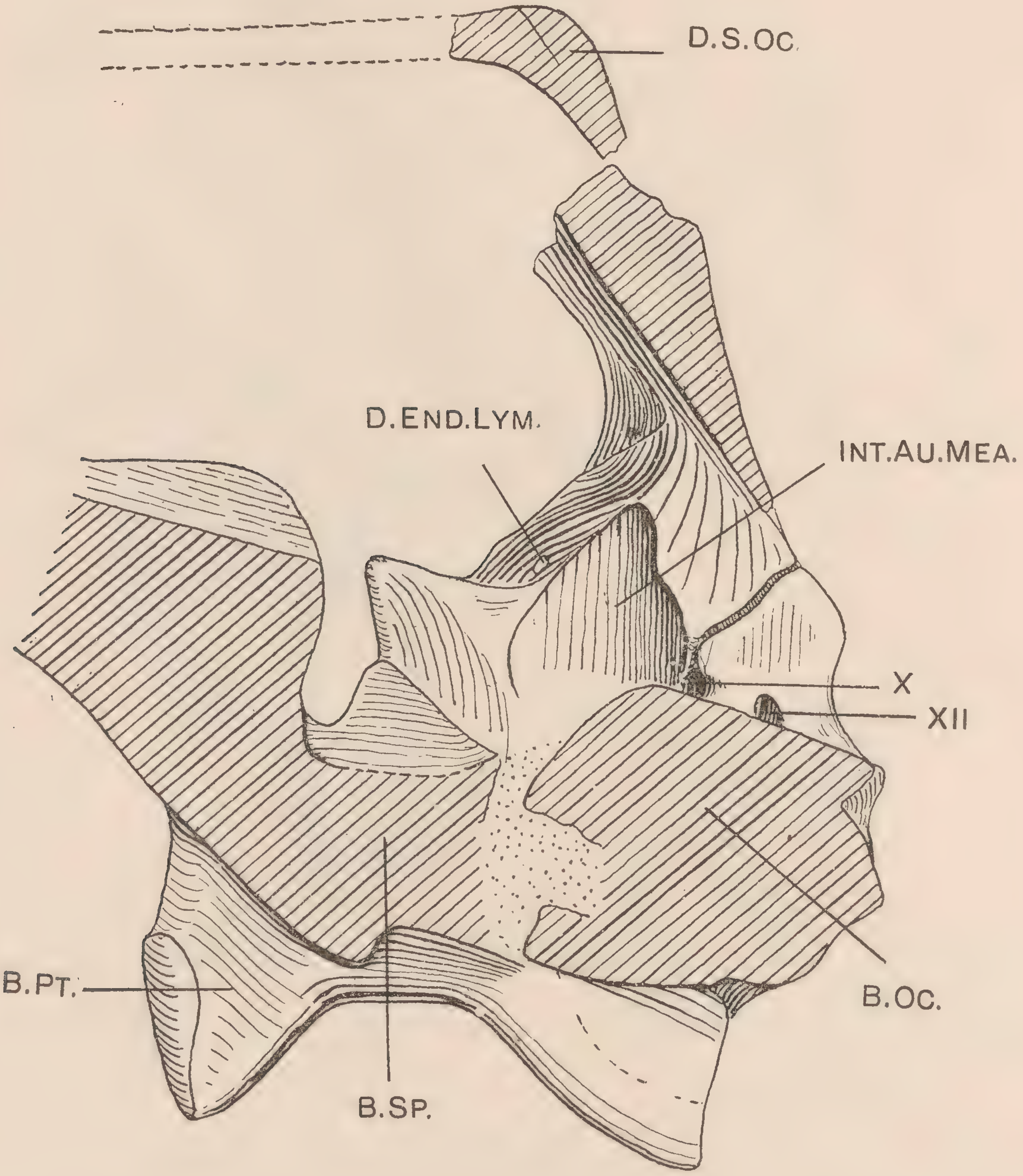

Fig. 11. Brain-case of the type specimen of *Diopeus* in sagittal section. Amer. Mus. No. 4155. × 1.
Reference letters as before.

by an articular face for the stapes immediately in front of which the bone forms the posterior margin of the fenestra vestibuli.

Dorsally the bone articulates with the supraoccipital and in front is covered by the proötic. On the inner surface the foramen jugulare is confluent with the internal auditory meatus owing to the depression of the ridge which separates them below the general level of the endocranial surface. The notch so formed represents the fenestra rotunda.

Supraoccipital. The supraoccipital is a large bone, expanded at the top so that its lateral border and that of the paroccipital form a single slightly concave area with which the tabular articulates, so that the suture between them on the occipital surface is nearly straight and stands vertically.

The upper part of the supraoccipital forms a thin sheet whose posterior surface is overlapped by the postparietals and which does not reach the parietals. Ventrally on each side the bone thickens and articulates with the proötic and paroccipital, so as to form the upper border of the very large internal auditory meatus; a groove for a blood-vessel runs outwards from the front face of the supraoccipital passing dorsal to the proötic. A small foramen for the ductus endolymphaticus issues on the inner surface of the bone.

Proötic. The proötic is probably a rather small bone. It covers the anterior face of the paroccipital and articulates below with the basisphenoid. It contributes to the paroccipital process and forms the anterior margin of the upper part of the fenestra vestibuli. Above this opening it is pierced by the foramen for the VIIth nerve, which is overhung by a short crista proötica.

Stapes. The very remarkable stapes has been already described by Cope and Case; it is an immensely heavy rod with two distinct faces separated by a deep notch at its proximal end and perforated by a rather large foramen. The larger of the two heads articulates with the margin of the fenestra ovalis having quite distinct and closely fitting articular faces with the paroccipitals, basioccipital, basisphenoid and proötic. The smaller head articulates with the under surface of the paroccipital process.

Nerve exits. The determination of the nerve exits and other openings of the brain-case present no difficulty and it does not require a separate discussion.

General Discussion of the Brain-case of Early Tetrapods.

The primary object of Palæontology as of taxonomic Zoölogy is the development of a "natural" classification of animals, one that is which shall express real blood relationships between divers types. Such a classification may be either a vertical one, in which divisions founded on the divergent groups of the terminal members of a stock are carried down as far as possible, until in fact the various lines merge, or a horizontal classification in which all those members of a group, belonging to different phyla, which are in the same degree of advance in structure are associated.

Both of these methods are valuable, expressing as they do different aspects of the subject and both, if they are to be valuable, must be founded on a similar type of study; involving a search for those slowly changing palæotelic characters, usually inconspicuous and hard of access, which are the only real guide to affinities.

In discussing any animal or group of animals, it is essential clearly to realize what characters displayed by it are merely specializations, either of the apparently non-adaptive kind which often characterize species, or else adapting it for some special mode of life; such specializations tend to obscure relationships whilst emphasizing differences. After the rejection of these characters there remains another series which may themselves be divided into two groups, those which are common to groups known to be not closely allied, and are hence probably derived from very distant ancestors, and those which obviously represent advances on their ancestral condition, which when once acquired change very slowly and usually in a similar way in the diverse phyla of the group.

In discussing the brain-case of early reptiles it is therefore necessary to discover what features may be expected in a presumed ancestral type and then to discover how the known brain-cases of Permian reptiles are structurally related to one another.

To my mind the whole structure of the post-cranial skeleton of the Lower Permian reptiles of Texas as it has been gradually shown to us by Professors Williston and Case demands a derivation of the group from temnospondylous amphibians.

The complete structural identity of the primitive shoulder-girdle, arms, pelvis and hind leg of a reptile, arrived at by comparing what are obviously the more primitive features of these regions in *Seymouria, Diadectes* and *Limnoscelis* with the similar parts in *Eryops* and its allies, when taken in connection with the extraordinarily close resemblance between the juvenile vertebræ of *Seymouria* and embolomerous vertebræ of Amphibia seem to me to place this conclusion almost beyond dispute.

It is therefore possible that the *Eryops* brain-case may give a morphologically ancestral stage to that of Cotylosaurs.

The only other Permian Amphibian in which the brain-case is known is *Trimerorachis* described by Broom, but I have examined satisfactory material of two genera of Embolomerous Amphibia from the British Coal Measures. The chief features in which *Trimerorachis* differs from *Eryops* in this region are, that there is a XIIth nerve, that the exoccipitals do not reach up to meet over the foramen magnum, that the supraoccipital remains cartilaginous, that the inner ends of the paroccipital and proötic are so very incompletely ossified that the impressions of the outer surfaces of the semicircular canals lie on the outer wall of the bony endocranial surface and that owing probably to its incomplete ossification the proötic does not articulate with the "supratemporal" at its inner and upper corner as it seems to do [1] in *Eryops*.

Professor Williston has shown us that *Trimerorachis* is a highly specialized, secondarily aquatic form and these differences depending as they do to a large extent on defective ossification may be entirely and certainly are to some extent due to the general degenerate ossification due to its aquatic life. The primitively aquatic and infinitely more primitive *Pteroplax* of Carboniferous age resembles *Trimerorachis* in the general lack of ossification of the inner ends of the paroccipital and proötic and in the exoccipitals not meeting over the foramen magnum, but resembles *Eryops* in the strong antero-internal upper corner of the proötic reaching the skull roof and coming into close relation with the posterior end of the sphenethmoid.

Trimerorachis resembles *Eryops* in the fact that the parasphenoid forms the lower border of the large fenestra vestibuli and in the large size and perforation of the stapes which also seems to have a special articulation with the parasphenoid in both forms.

Comparing these types and evaluating their resemblances and differences so far as the very meagre material allows, leads me to believe that a morphological ancestor of the primitive temnospondyl stem would have the following characters:—

(1) Basioccipital large and fairly well ossified.

(2) Basisphenoid with a well defined sella turcica and small basipterygoid processes.

(3) Parasphenoid covering all the lower surface of the basisphenoid including the basipterygoid processes and lapping up behind them onto the sides of the bone, the upper edges in this region forming the lower border of the fenestra ovalis.

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[1] "Seems to do" because it is possibly really the parietal with which it articulates.

(4) Exoccipitals of moderate size, forming a small part of the tripartite condyle and with their dorsal ends in contact with the lower edges of the descending processes of the postparietals.

(5) Paroccipital (opisthotics) articulating with the exoccipital and basisphenoid, leaving a foramen jugulare. Distal end of the paroccipital articulating with the tabular (in advanced types this sends a process down the dorsal surface of the cartilage bone but does not do so in the primitive embolomerous forms *Pteroplax* and *Cricotus*). Proximal end of the bone not very well ossified so that the bony internal auditory meatus is very large.

(6) Proötic articulating with the anterior face of the paroccipital, with the basisphenoid below and with the tabular and supratemporal or parietal above. Pierced by a foramen for the VIIth nerve in front of the large internal auditory meatus.

(7) Inner ear placed entirely in the side wall of the brain cavity so that the vestibule lies almost or entirely above its floor and the summits of the vertical semicircular canals nearly reach to the roof of the skull. Fenestra ovalis large and stapes heavy and perforated.

The modern Amphibia both Urodeles and Anura show many resemblances to the theoretical primitive large amphibian brain-case. They are degenerate as far as concerns the basioccipital and basisphenoid, but the large parasphenoid still forms the lower margin of the fenestra vestibuli. The paroccipital and proötic still reach up to the very degenerate skull roof, the proötic of *Cryptobranchus* resembling that of *Eryops* very closely. The ear still lies entirely in the side wall of the cranial cavity and the semicircular canals still reach very nearly to the top of the skull. On the other hand in frogs and in some urodeles such as *Amphiuma* the inner ends of the pro- and opisthotic bones have ossified and separate the inner ear from the cranial cavity in the bony skull, except for the very small foramina for the VIIIth nerve and the ductus perilymphaticus and endolymphaticus.

On the whole the resemblances are such as to suggest some distant relationship between the living Amphibia and the Temnospondyls whilst the differences are to a large extent obviously due to the degeneracy and high specialization of the living forms.

Seymouria is on the whole the most temnospondyle in appearance of all known reptiles, and this resemblance extends to the incompletely known brain-case. This resembles the primitive amphibian type restored above:

(1) in the relations of the upper end of the exoccipital to the postparietal.

(2) in the connection of the tabular to the paroccipital by a process running down the dorsal surface of that bone,

(3) in the connection of the distal end of the proötic with the skull roof,

(4) in the widely open internal auditory meatus, and apparently

(5) in the position of the inner ear.

It differs, however, in the retraction of the internal anterior and dorsal corner of the proötic from the skull roof.

So far as they go these resemblances show that the primitive temnospondyl brain-case arrived at in the above discussion does really represent a morphological stage in the development of the reptilian ear, and shows that we are justified in using it, at any rate till something better is offered, as a term of comparison with which to compare other reptiles.

Diadectes though far more modified than *Seymouria* resembles the temnospondyl type in many features. These are:—

(1) that the exoccipitals meet below the brain over the upper parts of the tripartite condyle;

(2) that the paroccipitals are in contact with the tabulars;

(3) that the proötic articulates with the tabular? and with the supratemporal by its anterior inner and dorsal corner;

(4) that the internal auditory meatus is widely open;

(5) that the inner ear lies almost entirely in the side wall of the brain-case;

(6) that the semicircular canals reach nearly up to the skull roof.

The brain-case of *Diadectes* differs from the temnospondyl type in:—

(1) not having the exoccipitals reaching the postparietals;

(2) the complete closure of the posttemporal fossæ by a bending down of the postparietals and tabulars onto the occipital surface; and

(3) by the long and low form of the cranial cavity.

Although I quite recently described and discussed the braincase of *Pariasaurus* it seems advisable to refer to it again in the light of the new knowledge of this region of Texas animals recorded in the present paper.

Pariasaurus resembles the temnospondyl type only in having the inner ear in the side wall of the brain-case, in the paroccipital meeting the tabular and in having the tabulars and postparietals only on the top of the skull.

It differs from them in the following features:

(1) The exoccipitals do not reach the skull roof.

(2) The proötic does not touch the skull roof.

(3) The internal auditory meatus is closed by bone leaving only a small foramen.

(4) The supraoccipital is a large bone forming a powerful process reaching to the parietals and postparietals.

(5) The fenestra vestibuli is entirely bounded by the paroccipital and proötic

(6) and in the long low form of the cranial cavity.

It is thus in this region far more advanced than *Diadectes*. The *Pari-*

asaurus brain-case resembles that of *Diadectes* in the long low form of the cranial cavity but differs widely from it,

(1) in the reduced proötic,

(2) in the mode of articulation of the neuro-cranium with the skull roof,

(3) in the form of the paroccipital process, and

(4) in the non-development of the flanges from the basisphenoid which cover the recti capitis muscles.

At the same time an accurate knowledge of the brain-case of *Diadectes* shows that the differences are not so considerable as I had formerly supposed on the evidence of the brain cast figured by Cope, Case and v. Huene which is extraordinarily misleading and should never have been published without a statement of the actual extent to which it is "restored."

The captorhinid brain-case so far as it is known resembles the temnospondylous type:

(1) in having the parasphenoid (or basisphenoid?) forming a large part of the border of the fenestra vestibuli,

(2) in the fact that the upper part of the tripartite condyle is formed by the exoccipitals which meet below the brain, and

(3) in the heavy stapes.

It differs from the amphibian type

(1) in not having the exoccipitals reaching the postparietals.

(2) in the complete absence of any connection between the proötic and skull roof,

(3) in the position of the postparietals entirely on the occipital surface,

(4) in the high wide plate formed by the supraoccipital, and

(5) in the high short brain-case behind the Vth nerve exit.

The brain-case of *Theropleura* resembles that of an amphibian:

(1) in having the exoccipitals meeting below the brain,

(2) in the widely open internal auditory meatus, and

(3) in the part played by the para-basisphenoid in the fenestra vestibuli, and

(4) in the heavy stapes.

It differs from this type very markedly:

(1) in the method in which the broad supraoccipital articulates with the postparietals and their position on the occipital surface,

(2) in the proötics and exoccipitals not reaching up to the skull roof,

(3) in the lower position of the inner ear where the vestibule lies to a considerable extent below the floor of the brain-case and the semicircular canals do not nearly reach the skull roof, and

(4) in the high short brain-case behind the Vth nerve exit.

The brain-case of *Theropleura* on the whole resembles that of *Dimetrodon* very strongly. The differences are:

(1) The mode of articulation with the tabulars which in *Theropleura* have a powerful articulation with the sides of the brain-case whilst in the more specialized genus they are thin splints overlapping the posterior surface.

(2) The production of the paroccipital processes backwards in *Dimetrodon* and their extreme shortness in *Theropleura.*

(3) The exceptional length of the process of the basioccipital for the tubera basisphenoidales.

In all the important features of this region the two forms agree; for example

(1) in the high and short brain-case and the position of the inner ear and fenestra ovalis,

(2) in the very remarkable way in which the foramen jugulare leaves in the closest connection with the internal auditory meatus,

(3) in the broadened supraoccipital and

(4) in the small proötic with a venous notch passing dorsal to it.

It must be noticed that all these are advanced structures not derived from Stegocephalia and not in any way paralleled by *Seymouria, Diadectes* or *Pariasaurus.*

The whole series, however, appear in a quite characteristic form in the South African Therapsids. The completely known brain-cases of *Dicynodon, Endothiodon* and *Lystrosaurus* agree quite closely with *Dimetrodon* and *Theropleura* in the features listed above and the primitive Gorgonopsid *Arctops* is as I have already shown singularly like *Dimetrodon* in the structure of its basicranial and otic region. In fact *Dimetrodon* differs from *Theropleura* in very much the same way in which *Arctops* differs from it. In the advanced Cynognathids the anterior margin of the proötic at its upper end has grown forward and upward so that it meets the parietal. *Theropleura, Dimetrodon, Scymnognathus* and *Diademnodon* form a structural series showing this gradual growth forward so that there is no doubt that the connection of the proötic with the parietal is purely secondary and has nothing to do with the primary connection in *Eryops* and *Diadectes.*

The complete differences between *Theropleura* and the Cotylosaurs *Diadectes, Pariasaurus, Seymouria* and *Procolophon* in the region of the brain-case will be obvious from the above descriptions and in all cases except *Seymouria* this difference is due to the different character of their advances; *Seymouria* differs solely in its very unadvanced nature, differs in fact in exactly the same way that *Eryops* does.

Captorhinus, however, differs very much less from *Theropleura,* in fact the only visible difference of importance is that the supraoccipital is not quite so wide; the types resemble one another not only in the general shape and structure of the brain cavity but also in very many minor details such as the mode of articulation of the stapes with the edges of the fenestra vestibuli. These resemblances add much weight to the view that the Captorhinids are allied to the Cotylosaurian stock from which the Therapsids arose, which has already been suggested by Professor Williston and supported by the present author.

Comparison of the brain-case of the Cotylosaurs with one another shows that *Seymouria* differs from the others in that this region has retained almost unmodified the temnospondyl condition, that *Diadectes* and *Pariasaurus* resemble one another in the length and lowness of their cranial cavity but differ in the persistent temnospondyl position of the tabulars and postparietals on the top of the skull in *Pariasaurus* and in the obliteration of the posttemporal fossæ in *Diadectes* as well as in the different arrangements of the basisphenoid and fenestra vestibuli.

Captorhinus differs in its short high brain cavity and in the condition of the fenestra ovalis, *Procolophon* in its quite *Sphenodon*-like occiput.

In conclusion I wish to express my gratitude to President Osborn and the staff of the Department of Vertebrate Palæontology in the American Museum for the generosity with which they placed the whole of their magnificent collections of early reptiles at my disposal, allowing me to prepare them at my pleasure, and for the many suggestions which I owe to the stimulating mental atmosphere of the Museum.

London, Mar. 12, 1916.

56.81.7:14.71.4

Article XXXII.— RECONSTRUCTIONS OF THE SKULLS OF THREE PELYCOSAURS IN THE AMERICAN MUSEUM OF NATURAL HISTORY.

By D. M. S. Watson, M.Sc., Lecturer in Vertebrate Palæontology in University College, London.

There are in the collections of the American Museum three skulls of Pelycosaurs which, although they are somewhat disarticulated, crushed and fragmentary, show the sutures with clearness. As they represent rare types, very incompletely known, and of special interest, it is desirable to make reconstructions of them.

This paper explains in some detail the methods I adopt in treating such material and the resulting figures will I hope be useful because by the method of reconstruction on which they depend no errors of morphological importance can be introduced, that is the contacts and relations of the individual bones will be correctly represented, although the general shape of the skull may not be very accurately reproduced.

(1) Edaphosaurus pogonias *Cope.*

Cope's famous type specimen of *Edaphosaurus* has been the subject of restorations by Case and Broom and has recently been described by v. Huene, but the accounts of these authors differ so considerably that it seems advisable to rediscuss it, especially as the new skull described by Professor Williston does not show the sutures clearly although being uncrushed it gives a perfect knowledge of the shape. The very different proportions of the parietals and interorbital widths which can be directly measured on the top of the skull in these two specimens show that they belong to different species.

Professor Williston's specimen shows that we shall not be far out in regarding the interorbital surface as flat. In our specimen there is a slight concavity between the lateral edges of the parietals and some evidence that they formed a rounded surface anteroposteriorly passing smoothly into the interparietal on the occipital surface.

The sutures separating the parietals, frontals, postorbitals, postfrontals, nasals and prefrontals are quite plain on the specimen.

The whole supraorbital border is preserved on the left side and the upper border of the temporal fossa on the right; there is, therefore, no difficulty in making a reconstruction of these regions.

The next point to determine is the width of the skull. There are three places where this can be done.

a. The left premaxilla is present, complete and to all appearance undistorted. This gives the contour of the anterior end of the skull and a width on the palate by direct measurement.

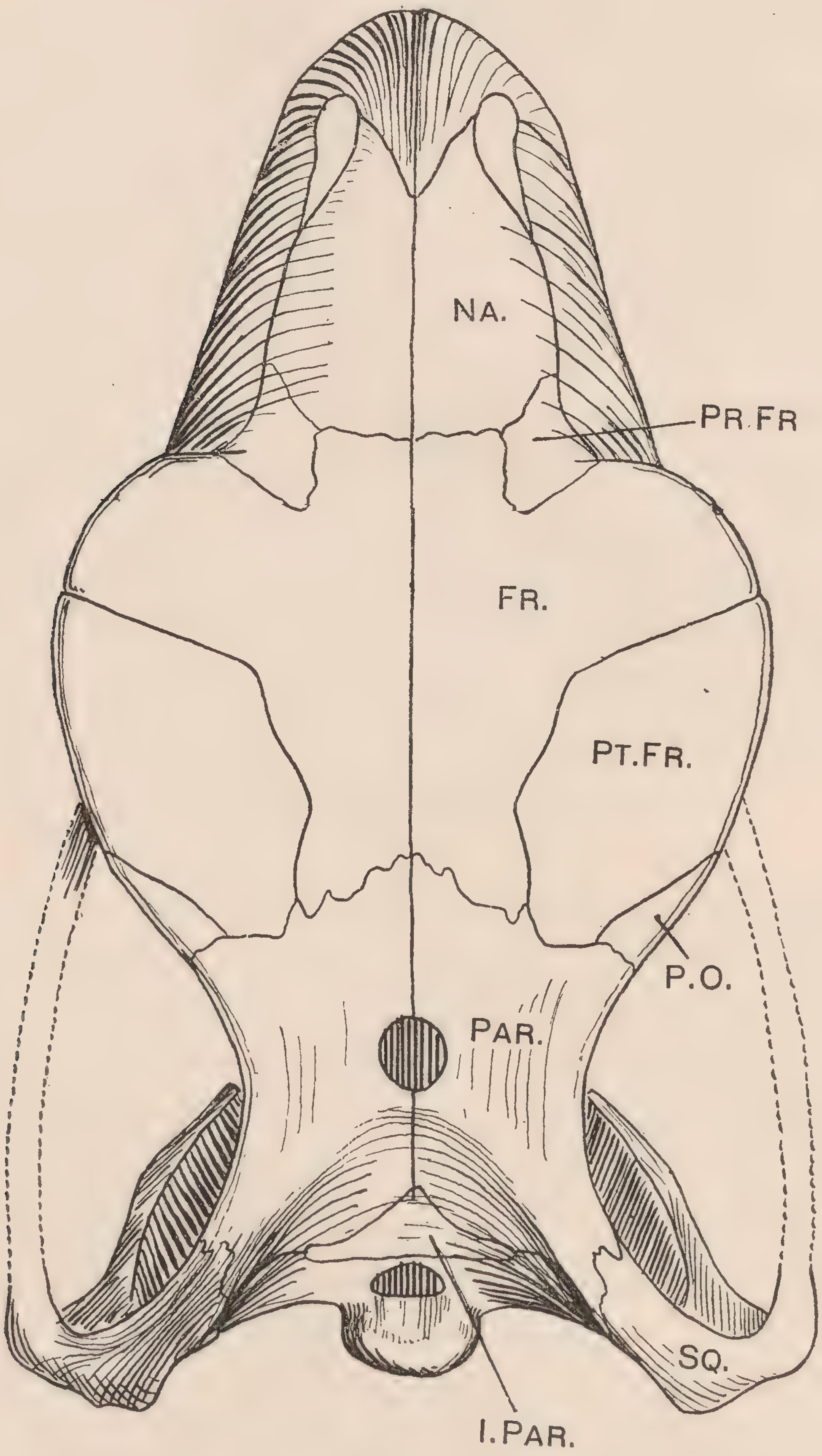

Fig. 1. *Edaphosaurus pogonias* Cope. Reconstruction of the type skull. Dorsal aspect. × $\frac{2}{3}$. *Fr.*, frontal; *I. Par.*, interparietal; *Na.*, nasal; *P. O.*, postorbital; *Par.*, parietal; *Pr. Fr.*, prefrontal; *Pt. Fr.*, postfrontal; *Sq.*, squamosal.

b. On the right side the inner edge of the pterygoidal part of the "dentigerous plate" is clearly a sutural face which must have articulated with its fellow. As this plate is in close connection with the maxilla and as the two sides give identical measurements we have fixed the width of the palatal surface of the skull in the region of the middle of the orbit.

c. The occiput is present, displaced and somewhat although obviously not much distorted, it gives with certainty the width beween the ends of the paroccipital processes. As the right squamosal is present and well preserved we have obtained, with only small possible error, another width on the extreme back of the skull.

By measuring with a flexible strip of paper the widths of the maxillæ, lachrymals, prefrontals and nasals in the same transverse plane in front of the orbits, it is easy to obtain the distance between the dentigerous edges of the maxillæ measured over the snout. The measurements of the two sides obtained in this way agree closely and as they are differently crushed we have assurance that the total measurement is probably very nearly right.

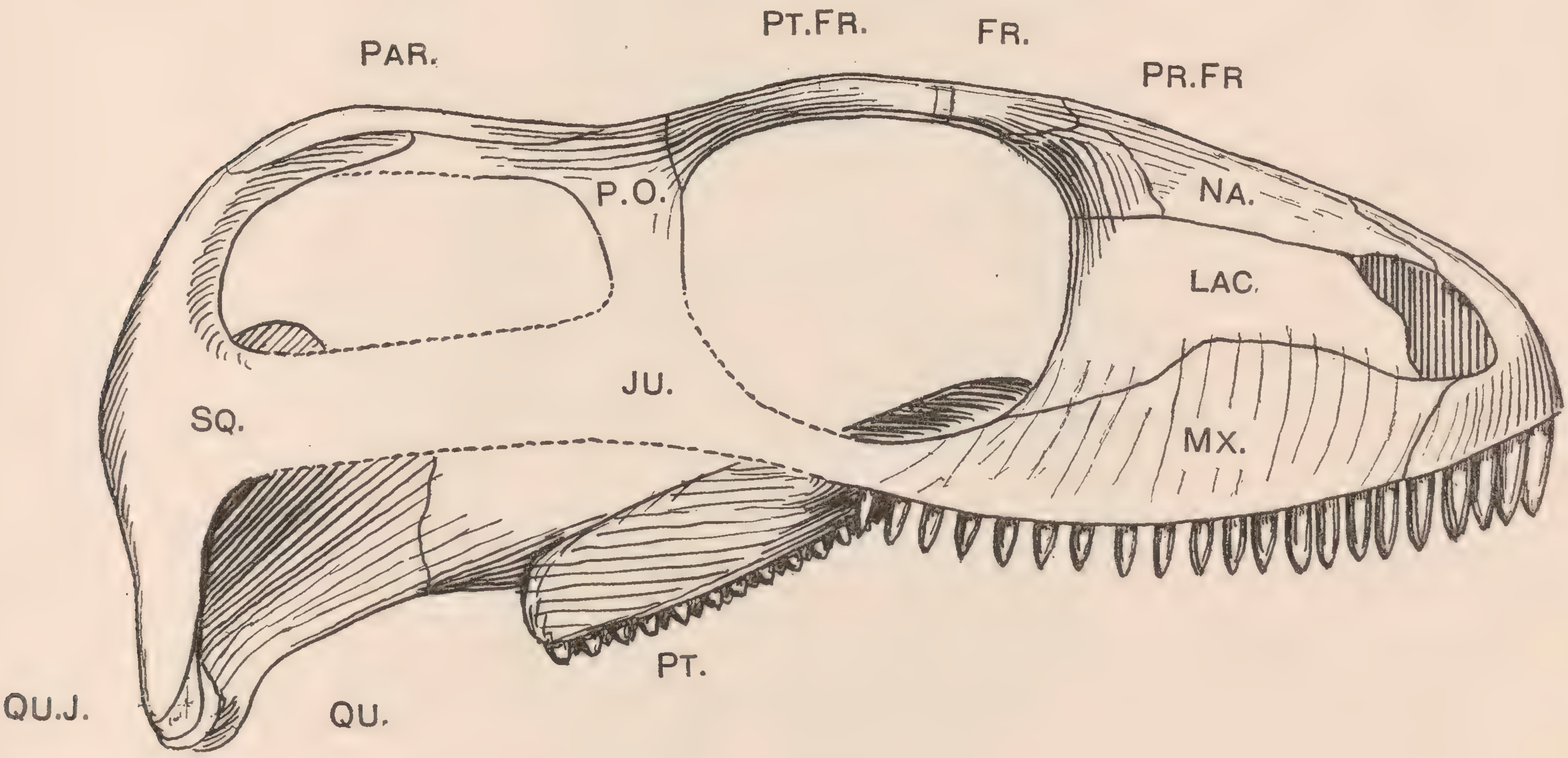

Fig. 2. *Edaphosaurus pogonias.* Reconstruction of the type skull. Lateral aspect. × $\frac{2}{3}$.
Reference letters as before with *Ju.*, jugal; *Lac.*, lachrymal; *Qu.*, quadrate; *Qu. J.*, quadratojugal *Pt.*, pterygoid.

As the width between the lower edges of the maxillæ is known by bending the strip of paper on which the measurements were taken we can obtain possible cross sections of the snout. The height of the orbital margin of the lachrymal which runs nearly up to the strongly overhanging supraorbital margin of the frontal gives us a minimum height for the snout, and the width between the ends of the fronto-prefrontal sutures on the orbital rim gives a near approximation to the width of the dorsal surface. The cross section of the snout just in front of the orbit is hence fixed within rather narrow possible limits.

By making projections from this section onto dorsal and lateral views of the skull, we get fixed points which with the curve shown in the apparently only very slightly crushed premaxilla and the known edges of the various bones concerned, enable us to reconstruct the face with some confidence.

As the left pterygoid is in natural articulation with the maxilla and the right with the basisphenoid, which has its natural relations with the basioccipital, the position of all these bones is fixed with regard to the face.

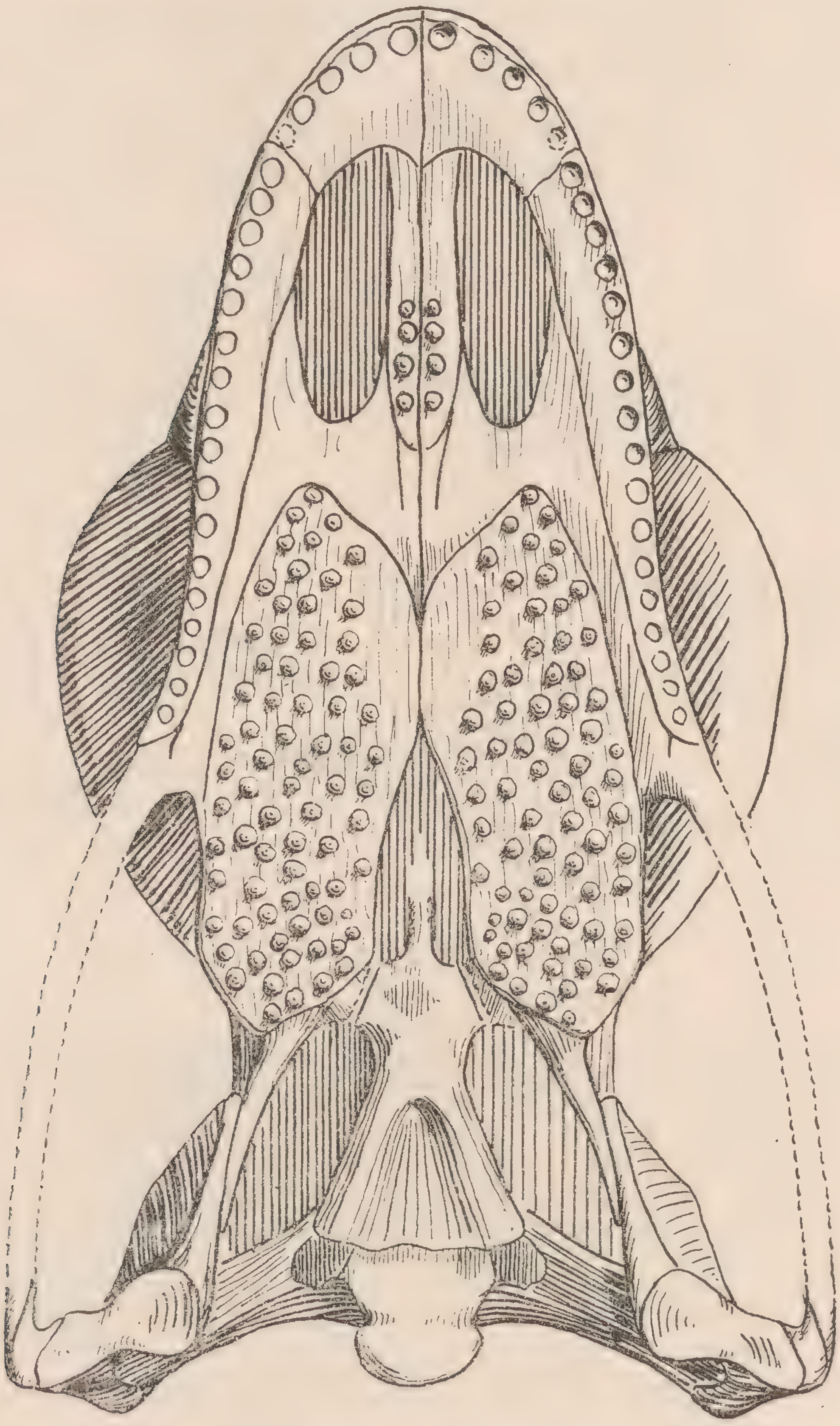

Fig. 3. *Edaphosaurus pogonias.* Reconstruction of the type skull. Palate. × $\frac{2}{3}$.

As the right pterygoid is in natural articulation with the quadrate, we have the distance of that bone from the basipterygoid process fixed and as we already know the position of the squamosal at its articulation with the end of the paroccipital process and the mode of articulation of this bone with the quadrate is clear, we have the width between the quadrates and their anteroposterior position fixed with a possible error of certainly not more than one centimetre.

Having these points fixed by measuring with a strip of paper the distance from the middle line to the quadrate condyle we get the contour of the occipital view and as the interparietal and tabulars are well preserved and clearly shown this gives us the whole structure. With all these points fixed by independent means the reconstruction of the rest of the skull is merely a matter of filling in checked by measurements and projections onto dorsal, ventral and lateral planes and hypothetical cross sections.

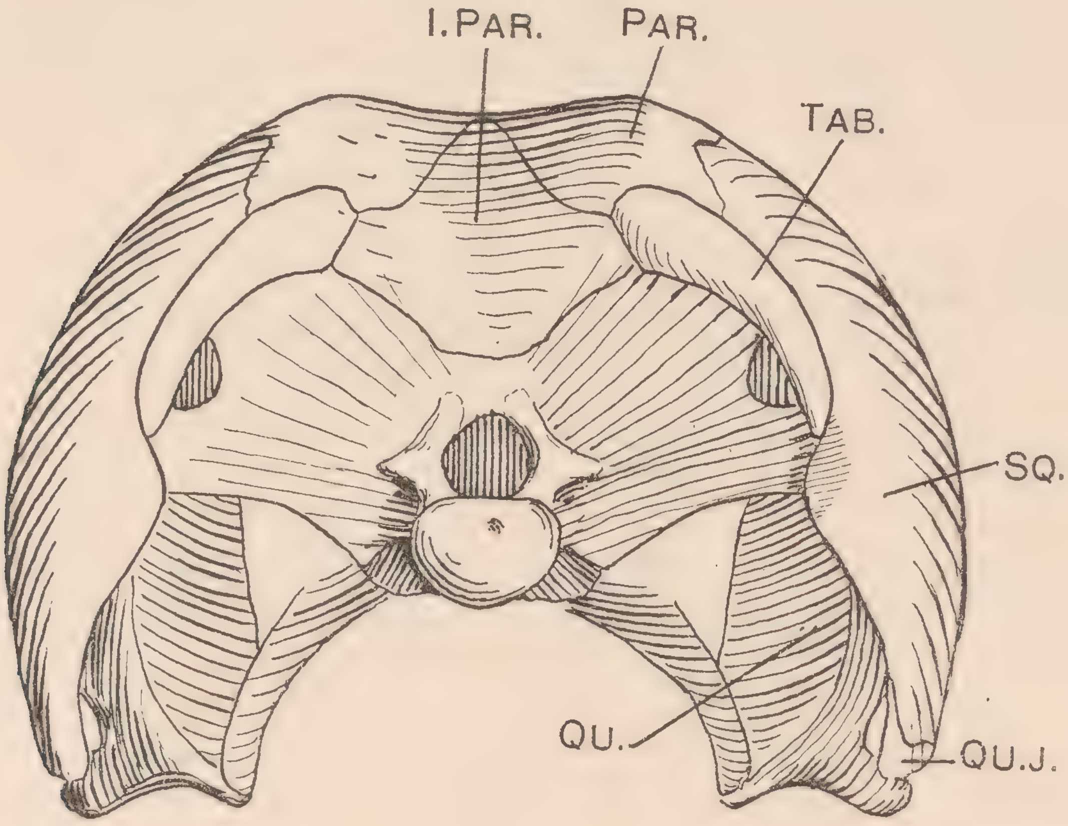

Fig. 4. *Edaphosaurus pogonias.* Reconstruction of the type skull. Occiput. × $\frac{2}{3}$. Reference letters as before with *Tab.*, tabular.

(2) Diopeus leptocephalus *Cope.*

The type skull of *Diopeus leptocephalus* Cope (Amer. Mus. No. 4155) is one of the most interesting pelycosaur skulls in existence and deserves fuller treatment than it has received.

Some time ago the various fragments were fitted together and restored in plaster by Mr. O. Falkenbach under the direction of Dr. W. D. Matthew. This restoration is apparently very good so far as concerns the preorbital region, but certain changes seem necessary in the hinder part.

The whole occiput is readily articulated, the bones fitting excellently. It has been described and figured in the preceding paper.

The left tabular is nearly complete and a small mass of bone is articulated with its outer edge; this is clearly divided by sutures into three parts, two of which restricted to the anterior part of the fragment are clearly the posterior ends of the postorbital and parietal. The other runs back in contact with the outer margin of the tabular and is incomplete posteriorly.

The complete, uncrushed and very well preserved left squamosal is present in the material. It shows on its inner face a facet for the end of the paroccipital process, which fixes its relations to the tabular and attached piece of temporal region. The upper end of the squamosal is truncated obliquely by a ridge, above which is a sutural surface rather distinctly divided into two parts, an inner for the parietal and an outer for the postorbital, which have quite correct relations with the pieces of those bones attached to the tabular.

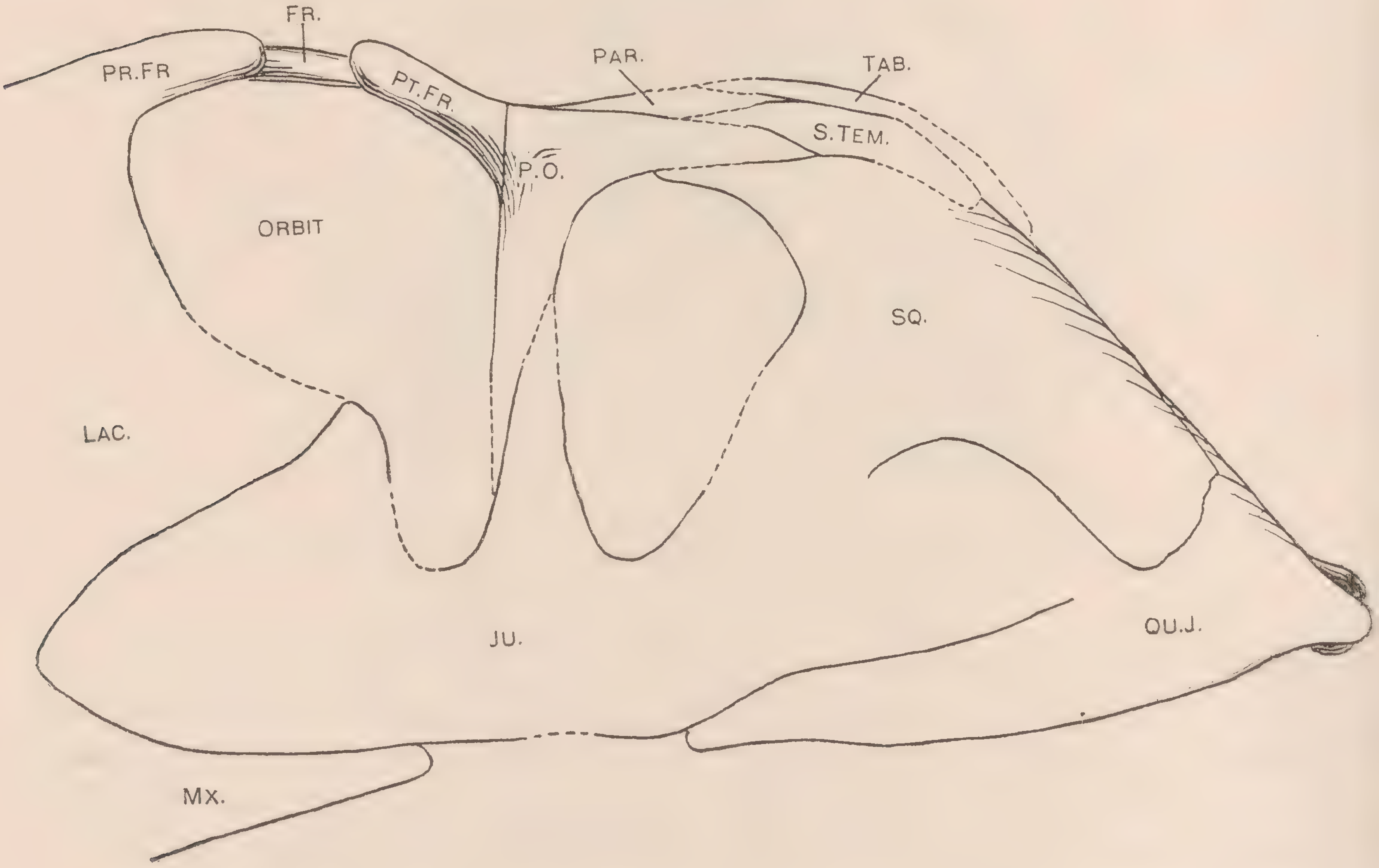

Fig. 5. *Diopeus leptocephalus* Cope. Reconstruction of the posterior part of the type specimen. × ½.

Reference letters as before, with *S. Tem.*, supratemporal.

Behind the fragment on the posterior surface of the squamosal are two much less well marked articular areas, the inner of which is obviously for the continuation of the tabular, which is shown by it to reach down to the paroccipital process outside the temporal fossa; whilst the other is for the continuation of the outer bone, the "supratemporal" which stops dorsally to the lower end of the tabular. The specimen thus gives certain evidence of the presence of a supratemporal in exactly the position in which it was found by Case and later by v. Huene in *Dimetrodon.*

The upper part of the left tabular has attached to it the outer corner of the postparietal and another fragment with a poor fit retains much of the rest of that bone with the hinder edge of the parietal articulated with it.

The nearly complete right parietal has articulated with it parts of both frontals, giving the middle line, and nearly all of the right postfrontal. The left postorbital is preserved, and its position is fixed by that of the parietal and postfrontal. The postorbital bar of the left jugal and the whole of its anterior part in natural articulation with the lachrymal and prefrontal are preserved, giving with considerable certainty the structure and shape of the orbit and the relations of all the circumorbital bones.

The postorbital bar and part of the posterior ramus of the right jugal are preserved, and both quadrates and quadratojugals, the left with some of the posterior part of the jugal in connection.

These various connections make the restoration of the top of the skull and the temporal region fairly easy and certain.

"THEROPLEURA."

The last skull (Amer. Mus. No. 4604) is more completely preserved than the type of *Diopeus.* It is somewhat distorted and crushed, the quadratojugals and part of the face between the orbit and the premaxillæ are missing. Its reconstruction is easy following the methods used in the preceding cases and it does not seem worth while to describe the details.

DISCUSSION OF THE SKULLS OF DIOPEUS (AMER. MUS. NO. 4155) AND "THEROPLEURA" (AMER. MUS. NO. 4604).

These two skulls represent closely allied but no doubt generically distinct animals; in all important features of their osteology they agree closely and are clearly members of the same family.

In the general structure of the skull they resemble *Varanosaurus* and even more closely Williston's recently described *Mycterosaurus.*

The skull of *Diopeus* is of very great interest because on it Cope founded his view of the presence of two temporal arches in Pelycosaurs, subsequent extension of which has created great confusion in reptilian classification.

One other specimen, the magnificent skeleton of *Ophiacodon* in the Walker Museum, is now held by Professors Williston and Case to show two

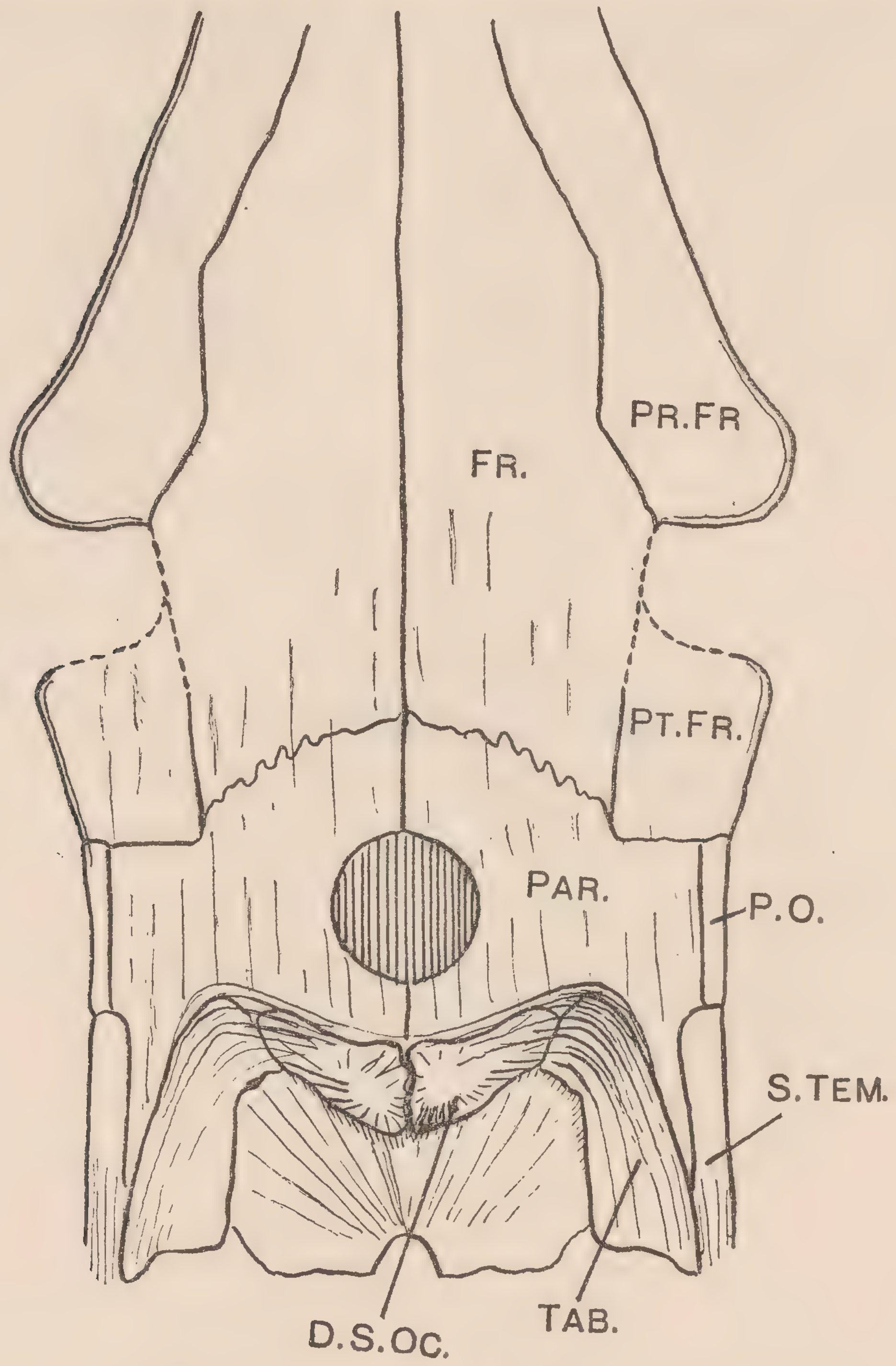

Fig. 6. "*Theropleura*" No. 4604, A. M. N. H.
Reconstruction of posterior part of skull. Dorsal aspect. × ⅔.

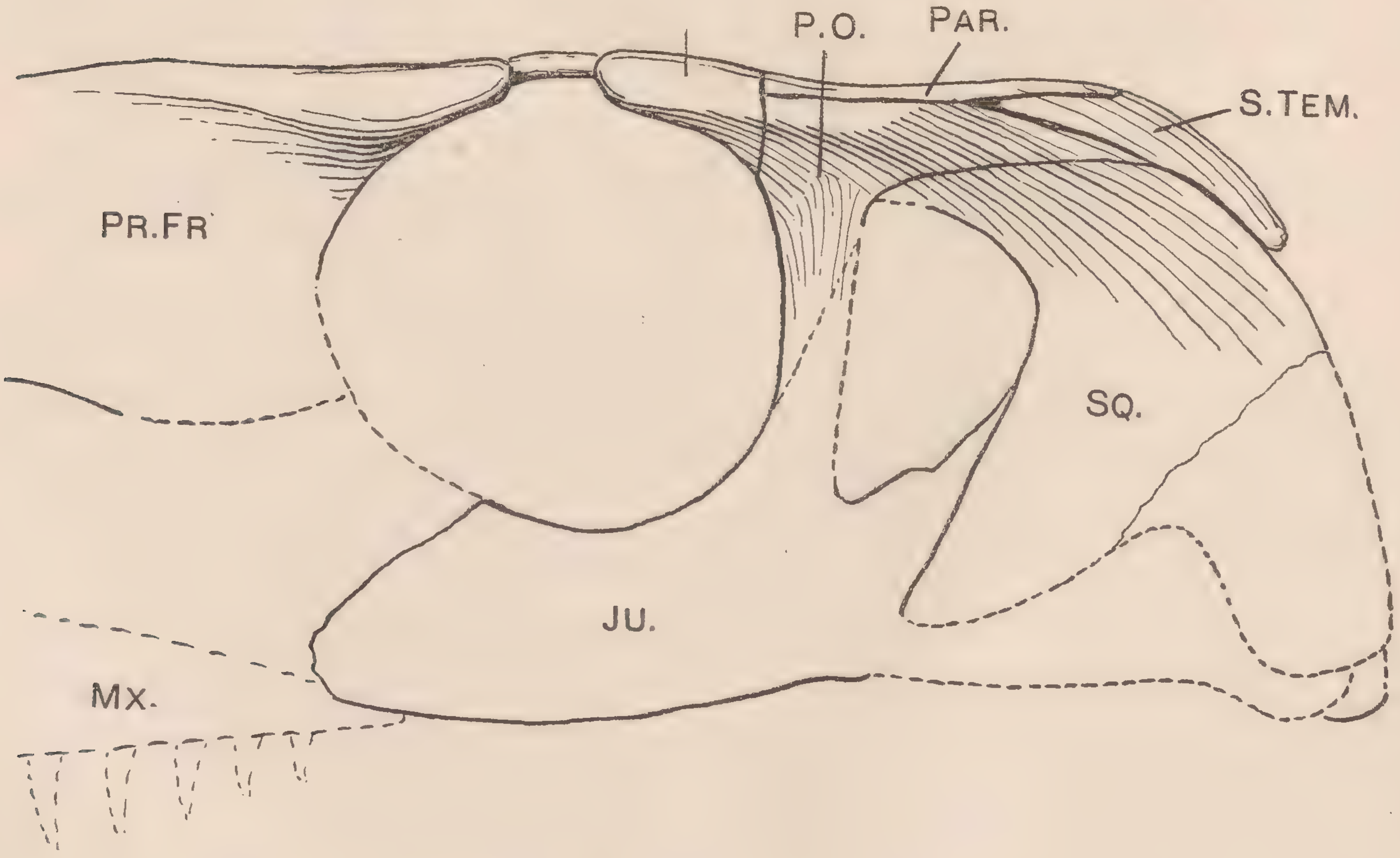

Fig. 7. "*Theropleura*" No. 4604, A. M. N. H.
Reconstruction of posterior part of skull. Lateral aspect. × ⅔.

temporal vacuities. Through the kindness of Professor Williston I had an opportunity of examining this skull, and am convinced as everyone must be of the actual occurrence of the very small upper temporal vacuity. The skull seems to me to show the structure more completely than was recognized in the original description, and leaves no doubt that the foramen lies between the postorbital and squamosal below and the parietal and supratemporal above, the latter bone not being distinguishable but from the evidence of the nearly allied *Diopeus* certainly present. It is quite certain from the evidence given by the small mass of bone still connected with the tabular in the type specimen of *Diopeus,* which is referred above, that there is in that animal no fenestra in a similar position. It will be noticed that this opening lies in the position of the "Upper Temporal Vacuity" reported by Baur and Case in *Dimetrodon.* That this opening is purely the result of post mortem dislocation is I think now recognized by all authors; in the original specimen where it is undeniably really present its sides show clearly sutural surfaces facing one another, and the numerous well preserved skulls since found show no trace of it. It is therefore extremely probable, to say the least, that the similar opening in *Ophiacodon* is also the result of crushing after death.

The remaining fenestra in *Ophiacodon* is surrounded by the postorbital, squamosal and jugal, being obviously homologous with that in *Dimetrodon* and in the South African Therapsids.

The large fenestra in *Diopeus* and "*Theropleura*" (4604) has exactly similar relations.

Cope's lower temporal fenestra in *Diopeus* is of very doubtful occurrence; nothing of the kind occurs in *Ophiacodon,* and its presence depends entirely on the evidence afforded by the single T-shaped squamosal and the apparently natural edge of a bit of jugal connected with one of the quadratojugals in the type specimen. These edges are polished by preparation and there is no evidence to show how much bone has been removed; 5 cm. added to each edge would close the putative infratemporal fossa.

It thus seems that the occurrence of two temporal openings in a Pelycosaur is still unproved, and from the material I have examined, by far the greater part of that so far collected, it cannot in my opinion be proved.

In his 'Revision of the Pelycosauria' Case held that *Diopeus* represented a morphological ancestor of *Dimetrodon.* My new studies have shown that this view has a fundamental basis of truth, although the animal is really somewhat specialized in a divergent direction. The feeble ossification shown in the brain-case and the limb bones suggests that the animal was aquatic and some of the peculiarities of its skull may depend on this mode of life.

Diopeus resembles *Varanosaurus* in the following in addition to common pelycosaur characters:—

1. In the great length of the face.
2. In the straight tooth row.
3. In the arrangement of the bones above the temporal fossa.
4. In the presence of a notch in the skull top above the orbit.
5. In the large quadratojugal on the side of the skull.
6. In the general build of the occiput.
7. In the short paroccipital process.
8. In the non-laterally compressed quadrate.
9. In the powerful parasphenoid.

Diopeus differs from *Varanosaurus* in the following advances and specializations:—

1. In the reduction of the quadrate ramus of the pterygoid which no longer approaches the squamosal.
2. In the carrying down of the quadrates far below the basi cranii.
3. In the great reduction of the quadrates.
4. In the articulation of the stapes with the paroccipital process by a special head.
5. In the non-production of the lachrymal to the nostril.

These resemblances and differences show that *Diopeus*, although it must have been derived from a *Varanosaurus*-like ancestor, is far more modified in many directions; some of these alternations (1, 2, 4, 5) are apparently of the nature of advances common to several stocks, others (3 and some not listed) are apparently specializations restricted to this stock.

Dimetrodon differs from *Diopeus* in the following characters, which are advances and specializations:—

1. The increased differentiation of the dentition and deepening of the maxilla.
2. In the curved tooth row.
3. In the obliteration of the supraorbital notch.
4. In the small quadratojugal.
5. In the fusion of the postparietals.
6. In the lengthening of the paroccipital processes in connection with the drawing back of the quadrate region.
7. In laterally compressed quadrate with a deeply grooved trochlear condyle.
8. In the reduced and upturned parasphenoid.
9. In the much reduced size of the basisphenoidal tubera and neighboring regions of the basioccipital and basisphenoid.
10. In the much smaller fenestra vestibuli.

11. In the different arrangement of the stapedial apparatus, and in the following preservation of a more primitive feature.
    (1) The rather large quadrate ramus of the pterygoid.

Dimetrodon is thus a more advanced and specialized type than *Diopeus,* which except for certain peculiarities such as the mode of articulation of the tabulars with the neural cranium does, as Case believed, afford a morphological ancestor for it.

EDAPHOSAURUS.

Certain features in the type skull of *Edaphosaurus pogonias* which were left doubtful by the previous investigators may be referred to here.

The interparietal and tabulars are just as they were recognized by Case; they lie on the posterior surface in a typical Therapsid way.

The specimen shows that the squamosal is continued forward and the postorbital backward below the parietal for a long way; it seems most probable that they met as they do in other Pelycosaurs, but the imperfection of the postorbital prevents confirmation of this view.

There seems to be no supratemporal, the apparent sutures in the squamosal being cracks.

There is a quadrate foramen, the quadratojugal articulating with the quadrate just above the outer condyle, then separating from it and finally articulating with its posterior edge just as in *Dimetrodon.* The quadratojugal is a small bone nearly the whole of whose outer and posterior surfaces is covered by the squamosal.

The skull of *Edaphosaurus* resembles that of *Dimetrodon* in fundamental features more than it does that of any other Pelycosaur, and such differences as do separate the two genera are largely dependent on their totally different adaptive specializations.

As is universally the case amongst animals with crushing teeth, *Edaphosaurus* has a very short face which preserves the primitive feature of a lachrymal reaching the nostril, lost in *Dimetrodon* and most other Pelycosaurs.

The palate is easily derived from that of *Diopeus* or even *Dimetrodon* by the exaggeration of the small teeth with which the pterygoids of each of these genera are beset.

The more vertical suspensorium, and lack of that pulling back of the quadrates and paroccipital processes which occurs in *Dimetrodon,* are also directly dependent on the development of the powerful palatal dentition.

The resemblances between *Dimetrodon* and *Edaphosaurus* are best seen in the brain-case and quadrate. Both have brain-cases differing in the reduction of the tubera basisphenoidales of the fenestra vestibuli, when compared with *Diopeus.*

As Case has already recognized the quadrate of *Edaphosaurus* is singularly like that of *Dimetrodon* in its lateral compression, the thrusting back of the outer condyle, and its relations to other bones.

Another very striking and important similarity is in the bone called "stapes" which is the same remarkable wing-like bone in both, differing very markedly from the stapes of *Diopeus.*

These resemblances between the skulls go with considerable similarities in the vertebral column in the development of the transverse processes and rib articulations, and in the deep, short, and wedge-shaped centra in the pectoral region.

These resemblances show that *Edaphosaurus* and *Dimetrodon* stand on the same level of evolutionary advance, and it seems not improbable that the adaptive differences may have been rapidly acquired.

59.7.35

Article XXXIII.— NATURAL HISTORY NOTES ON THE DEVILFISH, *MANTA BIROSTRIS* (WALBAUM) AND *MOBULA OLFERSI* (MÜLLER).

By Russell J. Coles.

"The story of the devilfish" by the late Dr. Theo. Gill (1) cited practically all the literature on the devilfish prior to 1908 and little has been written on the subject since. These notes are confined to some comparisons and observations by the author upon both *Manta birostris* and *Mobula olfersi.*

My observations on *Manta* are based upon eleven specimens as follows: one in July, 1909; two in June, 1914, which I killed for the American Museum of Natural History and as the water was exceptionally clear on both of the days on which these were killed, I observed them for some time at very close range before harpooning them. On April 6, 1915, I killed two large male *Manta* under conditions favorable for observation, and on April 11, 1915, I spent more than two hours moving my boat slowly around among six *Manta,* three of which were of very large size. I selected and killed a large female *Manta* 18 ft. 2 in. in diameter (body curve measurement) after a long and dangerous fight. I made a complete plaster-cast mold of this fish and, together with material parts of this specimen as well as of the two killed on April 6, sent them to the American Museum of Natural History.

My opportunities for observing *Mobula* have been much more extensive, as during the past five years I have killed about seventy-five examples (21 during July, 1914) and I have published some observations on this species (2).

Both *Manta* and *Mobula* manifest so little fear of either man or boat that they offer exceptional advantages for observation at very close range. I have spent hours in watching *Mobula* in the Bight of Cape Lookout, North Carolina, which region they visit during July.

In July, 1909, I saw a *Manta* in the Bight of Cape Lookout, North Carolina make its awkward leap and repeat the operation in less than a minute. At that time I thought that the *Manta* leaped clear of the water and so published (3) but later observations, and especially on April 11, 1915, when I saw three *Manta* leap, during more than two hours that I was among six of them, have convinced me that *Manta* never leaps clear of the water. Capt. J. J. McCann of Punta Gorda, Florida, informs me that he has never seen a *Manta* leap clear of the water, although in his thirty years of fishing on the Florida coast he has seen a great many, and his evidence is supported by others of the best type of native fishermen. I may also state that *Manta* does not produce the loud sound in leaping which has been credited to it by some writers.

In leaping, *Manta* rushes head first, until approximately half its body extends above the surface of the water, and its movements may then be likened to the rapid turning of a wheel on its axle, as it revolves rapidly, edge-wise, one pectoral disappearing as the other rises straight up and describes the arc of a circle, to be followed in like manner by the tail, which stands out absolutely rigid in the adults. The revolution was from left to right in all of my observations.

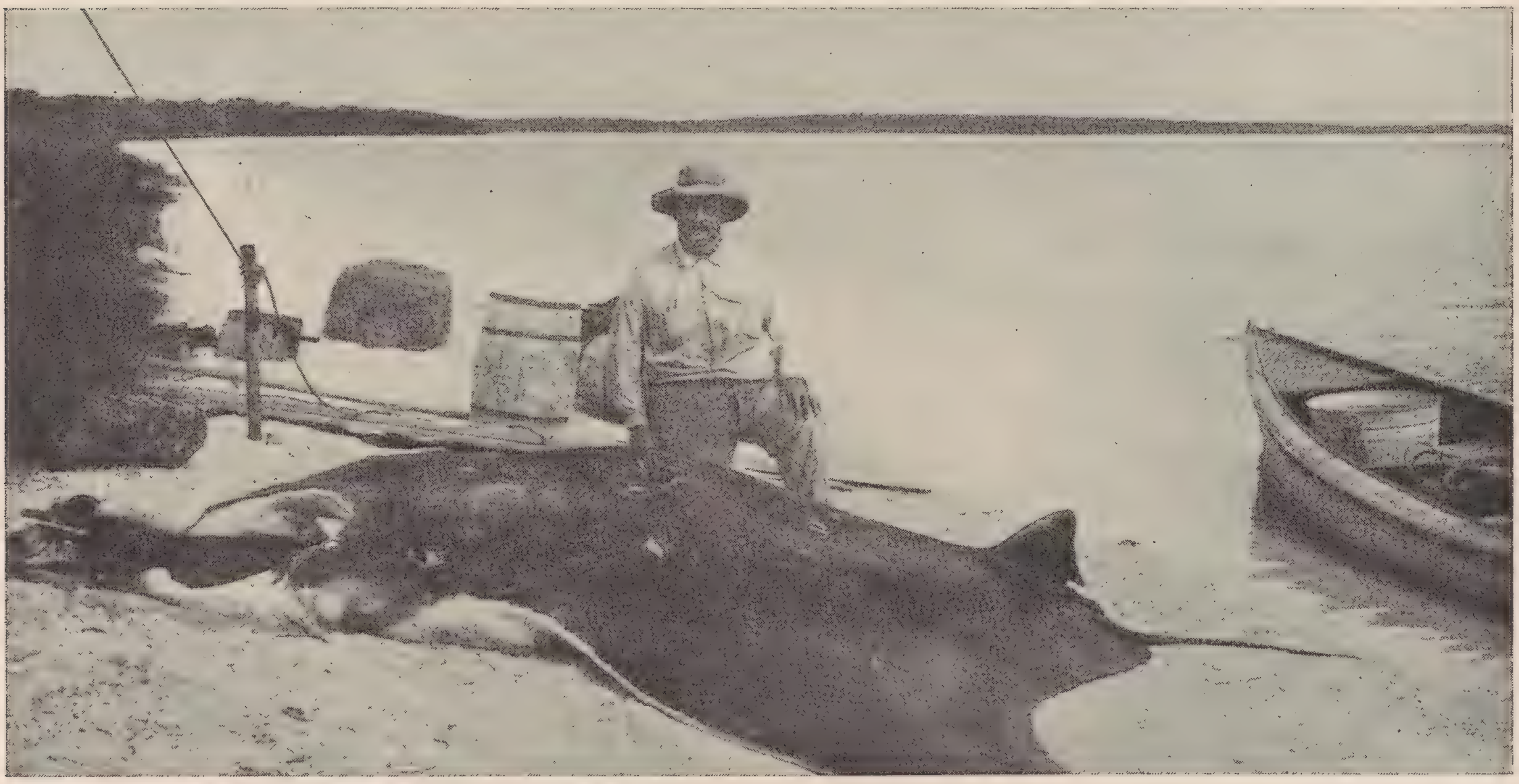

Fig. 1. *Manta*, side view. After 'Museum Journal.'

The leaping of *Mobula olfersi* is entirely different and very graceful. They leap at frequent intervals, rising lightly and rapidly until the entire body is at times more than five feet above the water, and they strike the water on returning to it with a loud noise.

Manta birostris and *Mobula olfersi* use the cephalic fins, extending forward at each side of the mouth, as an aid in securing food, yet the methods employed differ greatly. While feeding, *Mobula* are usually seen in small schools of from three to five, rapidly swimming in the shallow water near the beach. They carry their cephalic fins tightly curled up to a sharp point, until a school of small 'minnows' are sighted, then the *Mobula*

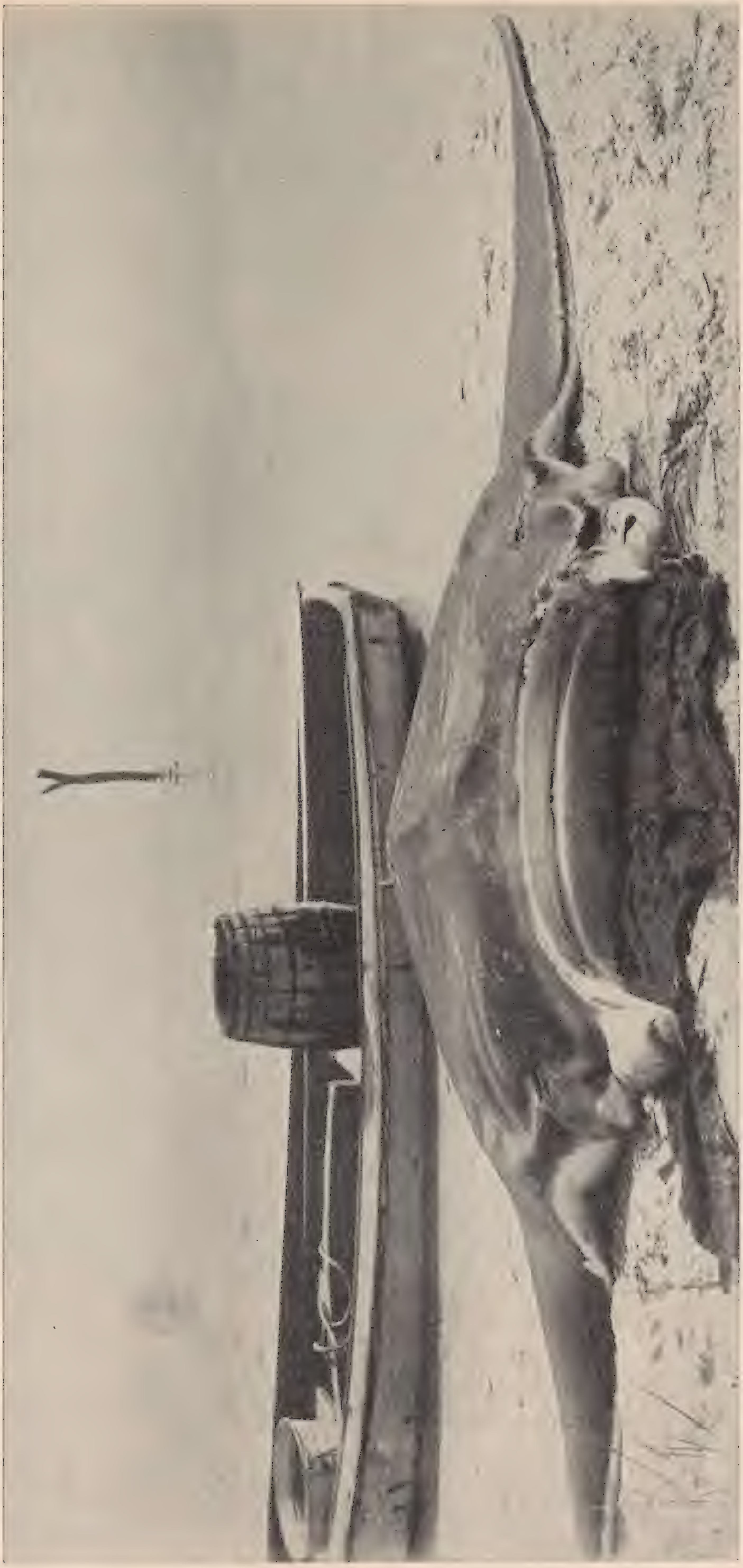

Fig. 2. *Manta*, front view. After 'Museum Journal.'

swing round in a semicircle and rush them to the beach, and at that instant these fins flash open and, meeting below the mouth, form a funnel, through which the 'minnows' are carried into the mouth. On the instant that this rush is over these fins again close up tightly. The *Manta*, while feeding, go alone, moving slowly, turning from one side to the other with constantly moving cephalic fins, one of them being used almost in the manner in which a hand is used, to throw the food, and, the other fin aiding in the operation, they for an instant form a funnel, which is quickly relaxed. The cephalic fins of *Manta* do not curl up as tightly or form as sharp a point as do those of *Mobula*.

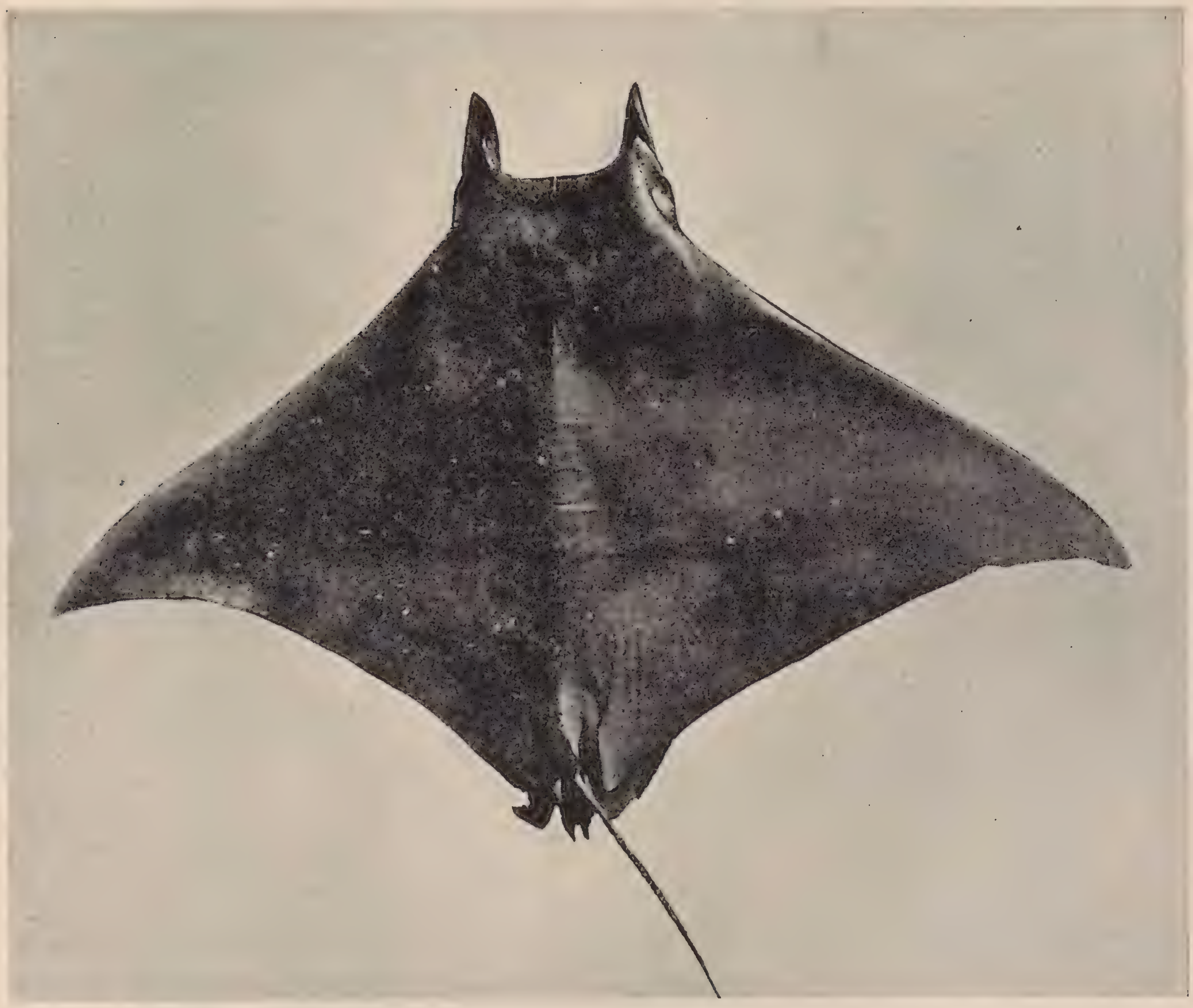

Fig. 3. *Mobula*, dorsal view.

Mobula migrate in large schools and although they break up into smaller schools while feeding they re-assemble, if only for a movement of a few miles along the coast. The *Manta* are much more solitary in habit and although quite a number have been observed in one day, they were widely scattered, except in the case of a mated pair. My observations of this ray on the coast of North Carolina are confined to one example, although they are seen there occasionally.

The skin of *Mobula* is smooth, while that of *Manta* is rough, being entirely covered with almost uniformly distributed, small, sharp, many-pointed tubercles.

The color of the back of *Mobula* is black, but on dying the fish becomes dark blue, and when first placed in formalin solution the color becomes more distinctly blue, of a somewhat lighter shade, and when changed into alcohol, the original black color is restored. But these changes are not accompanied by loss of pigment. The color of the back of *Manta* is dead

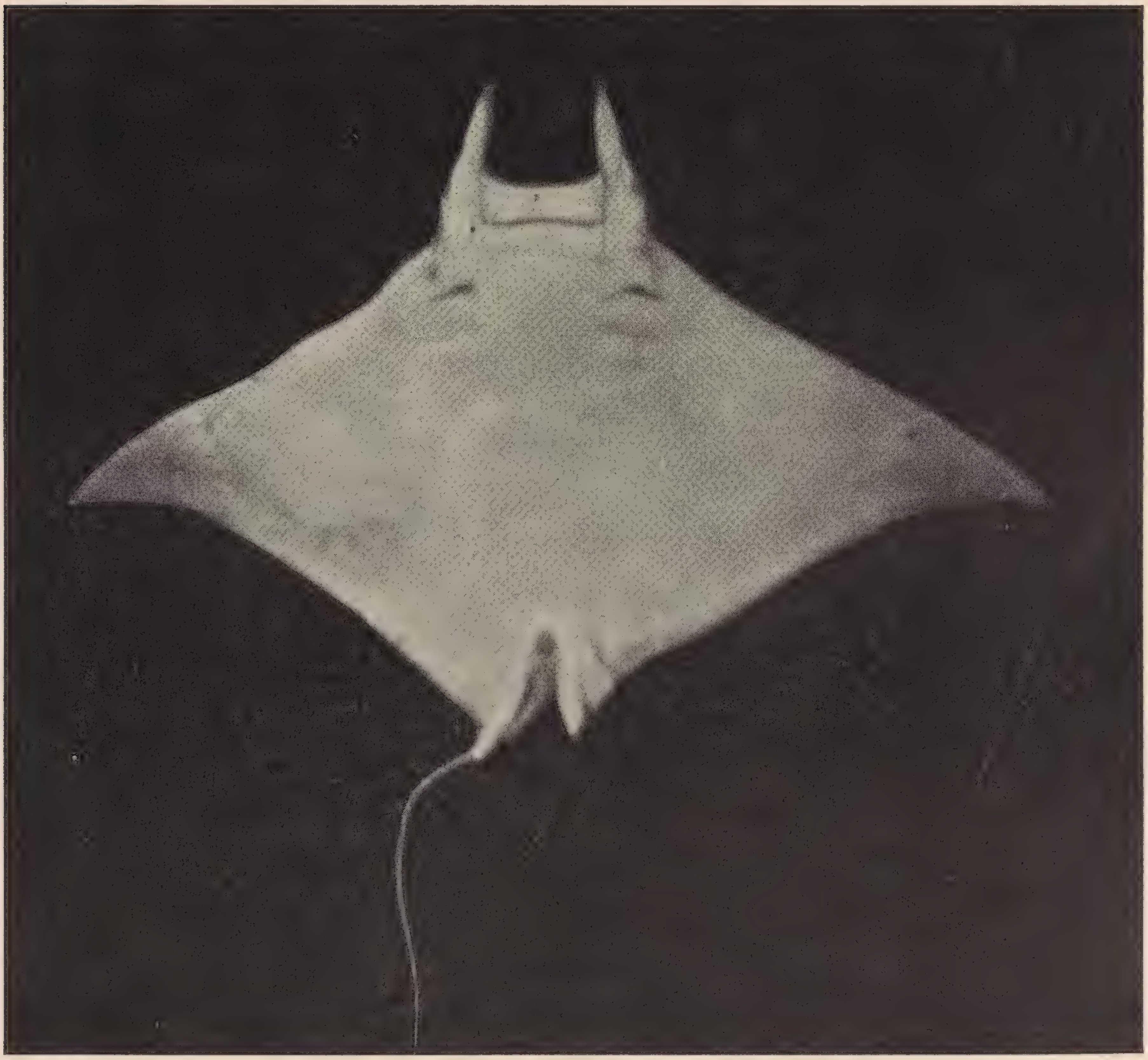

Fig. 4. *Mobula*, ventral view.

black, although specimens are frequently observed with dirty white patches showing on the dorsal surface. This change of color is due to the scraping off of the superficial coloring layer when the fish has been swimming at the surface for some time; the black color is restored when the *Manta* has remained beneath the surface for some time. While washing off the surface of a *Manta,* both the cloth and the water used became colored black by pigment, and the whole dorsal surface became lighter in color. I have also placed a handkerchief upon the skin of a dying *Manta* and observed that it was heavily coated with black coloring matter discharged from the skin.

The dying *Mobula* occasionally make a musical, bell-like sound. But three of five dying *Manta* emitted a harsh bear-like cough, somewhat similar although in greater volume, than that which is at times made by both *Dasyatis hastata* and *Aëtobatus narinari,* when dying.

Mobula olfersi has no tail-spine but it is apparent that *Manta* has at one time possessed a tail-spine although they do not now have such a spine. In the case of the five *Manta* killed by me, and several others which I have observed at close range, each had, near the base of the tail, a knob-like structure containing a bony substance, the tip of which was just protruding, and just back of this there appeared a deep trough, which was unquestionably a relic of the resting place of a spine in past ages.

In regard to the teeth: in *Mobula* there exists a small band of teeth in both the upper and lower jaws, which differ in the male and female as has been described by Dr. Jacques Pellegrin from specimens which I furnished (4). In *Manta* there is a small band containing many easily detachable teeth, but only in the lower jaw. I have found that a difference exists between the teeth of the male and female. This dentition will be fully described by Dr. L. Hussakof who has examined the dental strips of all five of the above mentioned *Manta.*

Mobula reaches maturity with a width of forty-four inches, or slightly less, and the width of adult specimens rarely exceeds four feet. The *Manta* do not reach maturity until they attain a width of more than eleven feet, and the average width of adults appears to be slightly under fifteen feet. However, I have observed for two hours one example (and was frequently in such close proximity to it that it at times touched my boat), which had a width of approximately twenty-five feet.

The tail of *Mobula* is very slender, smooth and flexible in both juvenile and adult, while the tail of *Manta* is always rough and only slender and flexible in juveniles. In adults it is thick and rigid, being flexible only at its origin.

After many tests I have found that the eyes of *Mobula* have independent action and although at times they are concentrated upon one object, at others they have double vision. After closely instructing my crew, who were in boat with me, to watch for this peculiarity in *Manta*, I and they, on several occasions clearly observed that they also have the same double vision.

I have published on the embryology of *Mobula* (5) and have since made observations on this point from which it is evident that *Mobula* gives birth to but a single embryo and that this is always contained in the left uterus. During capture it always expels the embryo, even if it is in an early stage of development.

I have made one observation on the young of *Manta*. It was made while killing the large female now in the American Museum of Natural History, as follows: Almost immediately after being struck by the harpoon, the *Manta* made the sidewise revolution alongside the boat, and just before the tail had reached the perpendicular an embryo was violently ejected to a distance of about four feet. The embryo appeared tail first, folded in cylindrical form, but it instantly unfolded and its pectorals, moving in bird manner, retarded its descent until the mother fish had disappeared beneath the surface. I was almost in the act of securing this embryo when it was swept below by a pectoral of the large male mate which was near the big female. This embryo was well advanced, with a width of more than three feet and a tail approximating eight feet in length. An examination of the uteri, which are now in the Museum, showed that the embryo had been contained in the left uterus, and the uterine filaments were richly charged with the thick creamy substance absorbed through the spiracles during the later stages of embryology.

I have captured *Mobula* with seine, harpoon, and with rod and reel, and find them exceedingly violent in their efforts to escape. But they die quickly when brought into the boat or landed on the beach. *Manta* has great vitality and the capture of the larger examples is attended with danger as they continue to fight violently for some time after receiving several whale lance wounds. In order to secure *Manta* specimens I have invented several devices, one of which was a very large drogue attached to a short harpoon line, which retarded the rushes of the fish; and another an enormous spade lance with which I sever the backbone of the *Manta* just back of the brain.

Mobula is unusually free from parasites but the *Manta* which I have observed have many parasites. Parts of their bodies are thickly covered with several species of parasitic crustacea, and the dental band is especially densely infested with them. I have not observed intestinal parasites in either *Mobula* or *Manta*. "Remora" also are often present on *Manta* and I counted seven large "Remora" attached to one example.

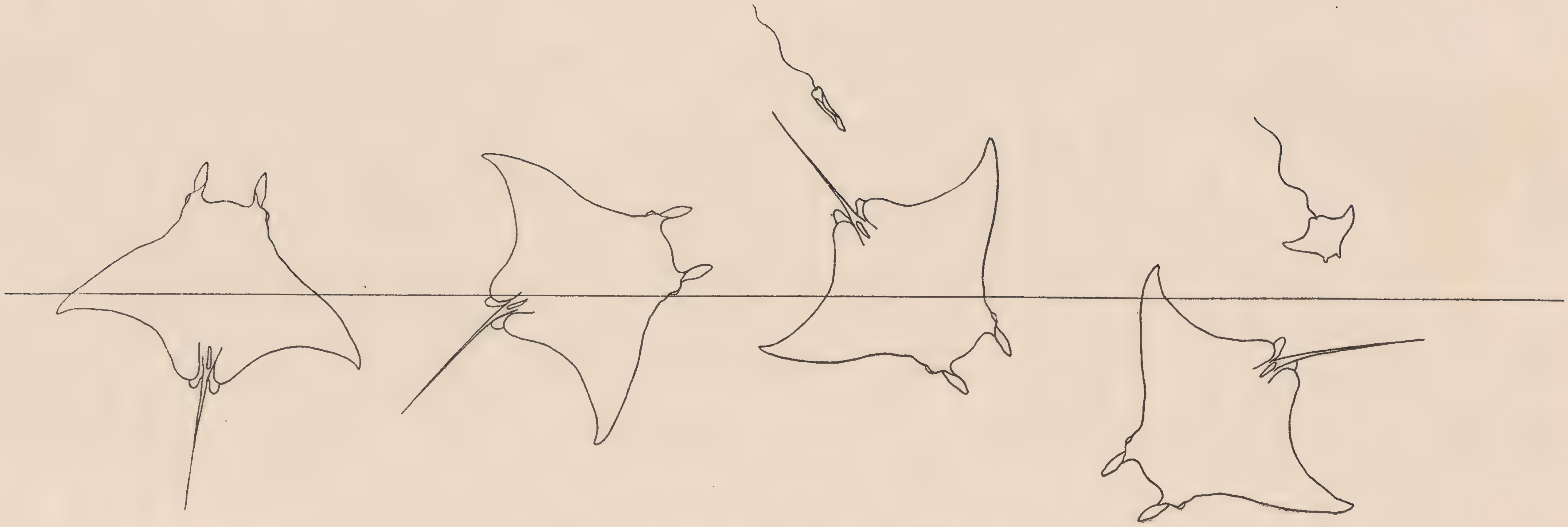

Fig. 5. Diagram illustrating birth of young *Manta*.

The weight of an adult *Mobula* is slightly under fifty pounds, while the weight of the large *Manta* in the American Museum is approximately six thousand pounds, and they occasionally attain much greater weight.

It has been frequently stated that the devilfish sometimes seizes hold of an anchor rope and tows a boat of considerable tonnage out to sea, but authenticated cases were lacking. I have whenever possible carefully investigated reported occurrences of this nature until I can now state that *Manta,* in swimming, does occasionally when striking against the cable of a vessel of small tonnage, lift the anchor from the bottom and tow the vessel for a considerable distance at a rapid rate of speed. I give below a case which I can vouch for.

In July, 1915, two native fishermen, Tilford Willis and Luther Gutherie, were lying at anchor just inside Beaufort Inlet, coast of North Carolina, when their motor fishing launch was suddenly lifted partly out of the water as the pectoral fins of a large *Manta* rose with a great splash on each side of the boat. The *Manta* then rushed against the boat cable, lifting the anchor and at great speed towed the boat out to sea against a strong wind and tide, and as it swam near the surface the anchor could be seen with one fluke hooked over the front of the head, between the extended horns or cephalic fins. The men at once started their engine and put their wheel hard over. When crossing the outer bar a heavy breaker which arose between the boat and the *Manta* threw the boat forward and to one side, and the anchor slipped off of the side of its head, freeing the *Manta.* The next day Mr. D. L. Taylor, his captain and other members of his party plainly saw from the deck of his yacht a *Manta* on the Beaufort outer bar.

The writer photographed Tilford Willis and Luther Gutherie and had them swear to their evidence before a magistrate, who also appended a statement as to the reliability of these two men.

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59.81.1C(729.1)

Article XXXIV.— DESCRIPTION OF A NEW AMPHISBÆNIAN COLLECTED BY THE LATE DR. CHARLES S. MEAD IN 1911, ON THE ISLE OF PINES, CUBA.

By Mary C. Dickerson.

Cadea palirostrata,[1] sp. nov.

Type, No. 2717, American Museum of Natural History, from San Pedro, Isle of Pines, Cuba, 1911, Charles S. Mead.

Paratypes, Nos. 2718 and 2719, American Museum of Natural History. No. 2718 has been deposited at the United States National Museum, Washington, D. C.

Description of the Type.— Premaxillary teeth, 7; maxillaries, 5–5; mandibulars, 8–8. Mouth inferior, muzzle extending beyond it a distance equal to the length of the nasal. Muzzle long and pointed. Head compressed with spadelike ridge extending dorsally from occipitals forward, and ventrally the length of the mental. Rostral large, compressed and extending in a conspicuously convex band forward and upward over the end of the muzzle, and backward to an angular suture with the præfrontal — thus adding to the adaptability of the head for digging. Præfrontal relatively large, its width little less than its length, compressed and folded over the dorsal ridge of the muzzle, indented anteriorly by the entrance of the rostral, and posteriorly by the two frontals. The latter equal in length to the præfrontal, widest in the middle. Frontals followed by a pair of subquadrilateral occipitals. Eye visible under the anterior angle of the ocular. Nostril pierced in the middle of the anterior end of the nasal. Supraocular very elongate, forming sutures with nasal, præfrontal and frontals, second labial, ocular and parietals. Three upper labials subequal, although of greatly varying shape; first slightly smallest, second slightly largest. Mental subquadrilateral with short winglike extensions anteriorly, and in the midline anteriorly compressed into a short downward-projecting wedge; chin shield nearly twice as long as mental, broadest near the anterior end; three lower labials, the first small, the second very large, twice as large as the second upper labial. Annuli, dorsal, 329; ventral, 286. Annuli on the tail, dorsal, 21; ventral, 16. Annulus on the middle of the body contains 39 segments. Dorsal segments narrow, oval; ventral, slightly broader than long, square-angled. No lateral line. Anal segments, 10; præanal pores, 10. General coloring brownish, darkest on head, lightest ventrally — each segment with one or more irregular brown blotches, varying in position on the segments.

Type: Length to vent, 280 mm.; tail, 15.

Paratypes: No. 2718, length to vent, 225; tail, 12. No. 2719, length to vent, 190; tail, 12.

The new species although very distantly related to *Baikia africana* recalls that species in the shape of the head, the cutting edge of the rostral being similarly developed, although that shield is not so enormously increased in size.

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[1] *Pala*, spade; *rostrata*, relating to the snout.

The new species is closely related to the form heretofore known as *Amphisbaena punctata* Bell, of Cuba, about which Stejneger has recently published a note referring it to the genus *Cadea,* with a specific name of *blanoides.*[1]

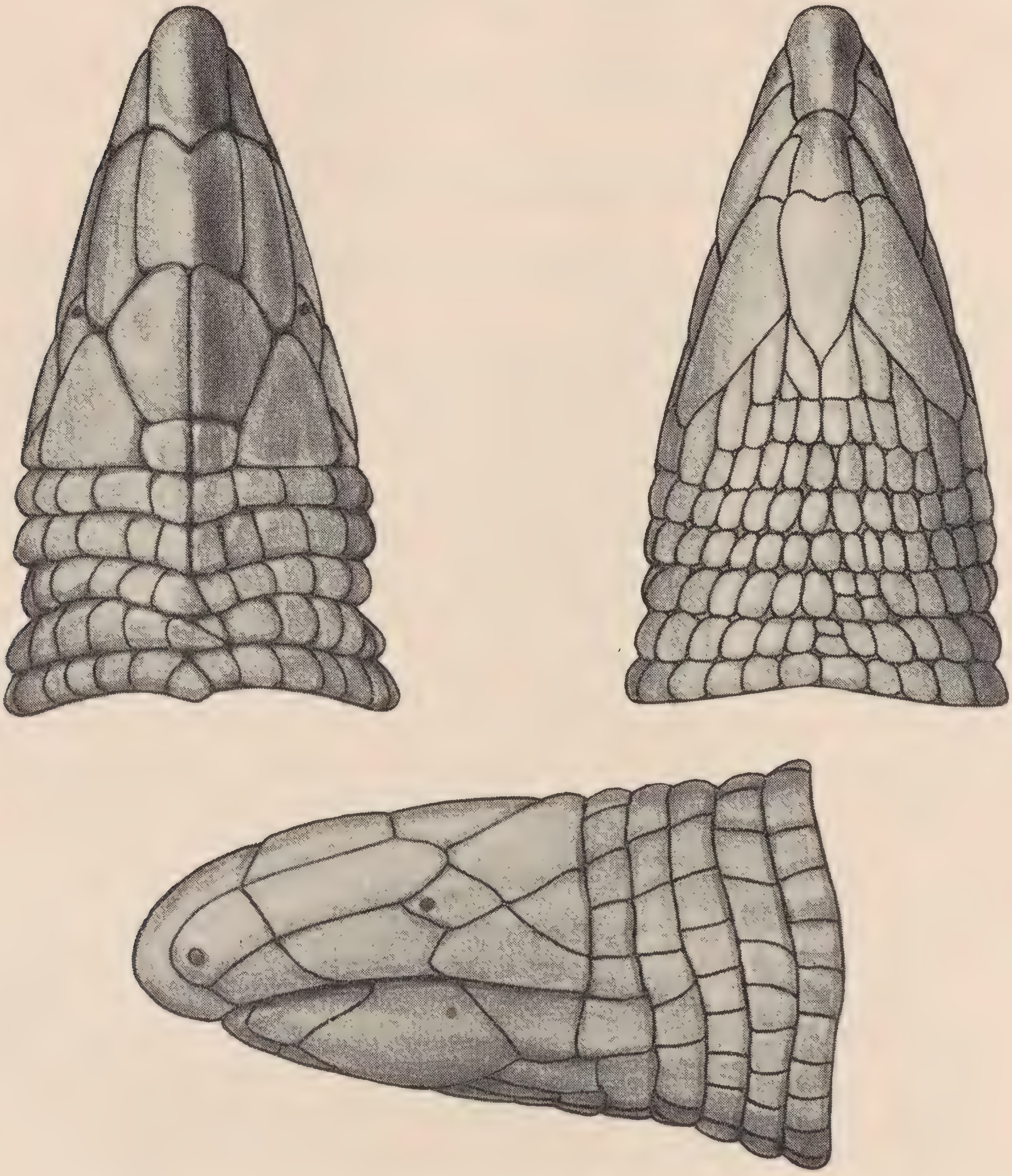

Fig. 1. *Cadea palirostrata* sp. nov. Dorsal, ventral and side view of head of type (No. 2717, A. M. N. H.).

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[1] The particular Cuban amphisbænian known in Boulenger's 'British Catalogue' as *Amphisbæna punctata* was first described in 1828 by Thomas Bell and placed under the genus *Amphisbæna* made by Linné seventy years previously, when only five species were known of the family of Amphisbænidæ, which now numbers more than seventy. Gray in 1844 created the genus *Cadea* for this amphisbænian, distinguishing it from the genus *Amphisbæna* because of its *separated nasals* and *single* large præfrontal plate, instead of *united nasals* extending across the muzzle, and a *pair* of præfrontals behind them. This was published in the 'Catalogue of Tortoises, Crocodiles and Amphisbænians,' of the British Museum (1844). In 1865 in the 'Proceedings' of the Zoölogical Society of London, Gray published

Boulenger's key, not recognizing the validity of *Cadea,* and giving the shovel shape of the head, as in *Baikia africana,* undue importance, carries the new species far astray from its real relationship. Scutellation, not the shape of the head however, must constitute the character of generic rank: the new species notwithstanding the unusual shape of its head, has certainly developed side by side with *C. blanoides* and is distinctly of the same genus.

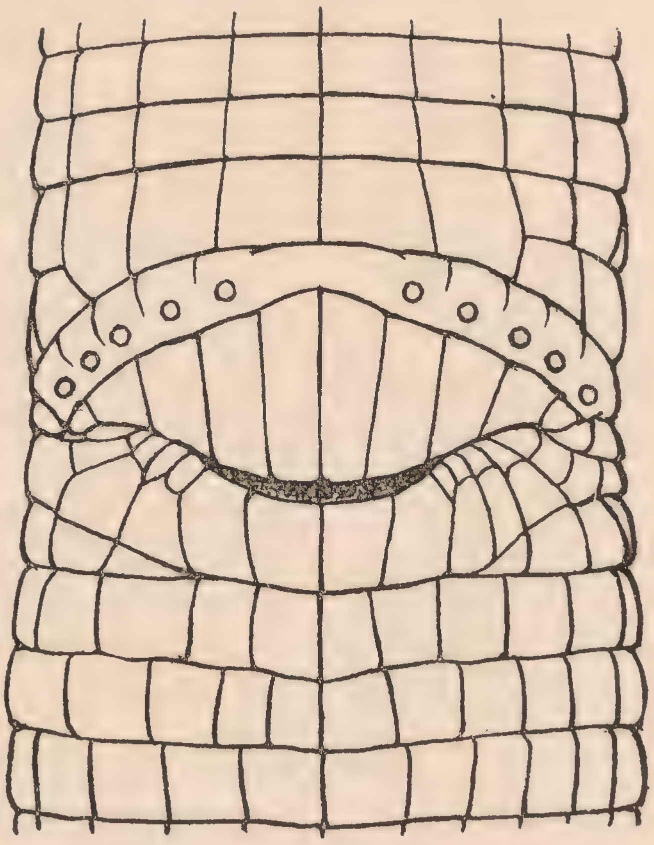

Fig. 2. *Cadea palirostrata* sp. nov. Ventral posterior of body to show number of anal segments and præanal pores.

Cadea palirostrata agrees with *C. blanoides* in the general conformation of the head shields: that is, nasals on the sides of the head, a single præfrontal, the long supraoculars lying between labials and frontal, forming sutures anteriorly with the nasal. It agrees also in general in the shape and arrangement of mental and chin shields. While agreeing thus, it differs in having the nasals form a suture only with the long rostral, while in *C. blanoides* the nasals form a longer suture with the præfrontal than with the rostral. The narrowing of the head in producing the spade effect has narrowed the præfrontal; the præfrontal is not greatly shorter however, than in *C. blanoides,* the greatly increased length of the rostral corresponding with a lengthened muzzle.

Attention is called to the fact that the description of the teeth of *Cadea blanoides* as given in the British Catalogue is correct, premaxillary teeth 7, maxillaries 5–5, and mandibulars 8–8. (This is in the face of some previous confusion. Duméril and Bibron gave a smaller number of maxillaries and this was quoted by Gray.) The two Cuban species, *Cadea blanoides* and *Cadea palirostrata,* therefore show closest relationship in this primary character.[1]

Thus the number of West Indian representatives of the tropical family

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a careful study of the then considerable collection of the British Museum and retained *Cadea.* Again, in 1872, for the third time, Gray presented a classification and description of amphisbænians in the 'Catalogue of Shield Reptiles' of the British Museum, and retained the name, *Cadea punctata,* giving *Amphisbæna punctata* as a synonym. *Cadea* is a valid genus, as has recently been stated by Stejneger in the 'Proceedings' of the Biological Society of Washington, April 14, 1916. Also, as Stejneger calls to our attention, the name *Amphisbæna punctata* was given by Wied to a Brazilian *Amphisbæna* in 1825 (three years prior to Bell's description of the Cuban species), and this Cuban species must therefore give up its specific name *punctata.* It thus becomes *Cadea blanoides* Stejneger.

[1] I wish to express my gratitude to Dr. Leonhard Stejneger for his help in loaning the American Museum a specimen of *C. blanoides,* that I might check up this point.

Amphisbænidæ is increased by one, making seven known species. With the exception of the two species of *Cadea*, all West Indian amphisbænians, including the third form known from Cuba, *Amphisbæna cubana*, are distinguished by paired præfrontals.

59.9,33(67.5)

Article XXXV.— SHREWS COLLECTED BY THE CONGO EXPEDITION OF THE AMERICAN MUSEUM.[1]

By N. Hollister.

Plates VII–XI.

The shrews collected by Herbert Lang and James P. Chapin on the American Museum Congo Expedition number 177 specimens, of 15 species and 3 genera. Almost one half of the species are new. This is not altogether surprising when it is considered how few shrews have been described from the Congo as compared with other parts of Africa. It nevertheless seems remarkable that five of these new species should be members of the small group of "naked-tailed" *Crocidura* of which only about ten forms were heretofore known. Five forms of *Crocidura* which have been recorded from the general region are not represented in this collection. These are *Crocidura turba turba* Dollman, *C. t. tarella* Dollman, *C. poensis attila* Dollman, *C. boydi* Dollman, and *C. nigrofusca* Matschie. Races of *C. hildegardeæ* and *C. fumosa*, as well as representatives of several west coast species also might reasonably be expected.

Owing to their damaged condition, immaturity, or other circumstances, five specimens in the collection are not determinable and are not listed in the present paper.

Of the localities listed below, Garamba, Faradje, Niangara, and Nala are in the Uelle drainage. Medje, Gamangui, Bafwabaka, Babeyru, Ngayu, and Avakubi are in the Ituri valley. Lubila is situated on a branch of the Tshopo, in the Stanley Falls district.

1. **Crocidura nyansæ kivu** *Osgood.*

Plate X, Fig. 1.

1910. *Crocidura flavescens kivu* Osgood, Ann. and Mag. Nat. Hist., Ser. 8, Vol. 5, p. 370. April. (Lake Kivu, Congo.)

Three specimens, including one in alcohol, from Avakubi; one specimen from Gamangui; and sixteen, including one in alcohol and one odd skull, from Medje.

Most of the skins in this series are in a pale, worn, and faded condition but some are in fresh pelage and show the dark body coloration and dark brownish feet characteristic of the race. The palest, most faded, specimens have the feet light colored, like the coat of the body. There is the variation in color usual in series of *Crocidura nyansæ nyansæ* and *C. n. kijabæ;* some of the skins have dark colored bellies while others have not. This seems to be individual variation and not a seasonal condition of pelage; the variation is found in young as well as in adult examples.

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[1] Scientific Results of the Congo Expedition, Mammalogy, No. 1.

The collectors record three pairs of inguinal mammæ.

2. **Crocidura sururæ** *Heller.*

1910. *Crocidura sururæ* Heller, Smithsonian Misc. Coll., Vol. 56, No. 15, p. 2. December 23. (Rhino Camp, Lado.)

One skin and skull from Faradje and an alcoholic specimen from Garamba agree in all essential details with the type series of this species from Rhino Camp, Lado Enclave.

3. **Crocidura lutrella** *Heller.*

1910. *Crocidura lutrella* Heller, Smithsonian Misc. Coll., Vol. 56, No. 15, p. 4. December 23. (Rhino Camp, Lado.)

A single skin (without skull) from Faradje is evidently of this species. Compared with the type series from Lado Enclave, this specimen, which is in older pelage, has a more grayish, less buffy belly.

4. **Crocidura turba nilotica** *Heller.*

1910. *Crocidura nilotica* Heller, Smithsonian Misc. Coll., Vol. 56, No. 15, p. 3. December 23. (Rhino Camp, Lado.)

Three specimens, including two in alcohol, from Faradje are typical of this form. A single alcoholic specimen from Nala, from which the skull has been removed, is evidently of the same subspecies. It is browner than usual for *nilotica,* but is the only July specimen seen.

5. **Crocidura caliginea** sp. nov.

(Plate VII, Fig. 1; VIII, Figs. 1, 1*a*.)

Type, No. 48555, Amer. Mus. Nat. Hist., skin and skull of adult ♀ (teeth moderately worn and basal suture closed) collected at Medje, Belgian Congo, July 8, 1914, by Herbert Lang and James P. Chapin. Orig. No. 2451.

A medium sized, very dark brown, dark bellied, small footed species, with thinly haired tail and with only a few long bristle hairs near base of tail.

Color.— Entire head and body, above and below, dark brown, near to clove brown; the upperparts very slightly brighter or more brownish, less smoky, than the belly; but there is no distinct line of demarcation nor noticeable difference in the shade of color above and below. The slightly brighter appearance of the back is due to a faint speckling in the hair of cinnamon or deep buff. Fur short and close, the undercolor deep neutral gray. Hands and feet brown, the digits yellowish. Tail blackish brown, slightly paler at base below, appearing naked but sparingly clothed with very short hairs; a very few longer hairs near base.

Skull and teeth.— Skull strongly built, with heavy maxillary processes. Braincase short, wider than long, with sharp, angular corners and straight sides. Teeth large; unicuspids from crown view very broad; third unicuspid distinctly larger than second, especially broader across crown; the teeth all crowded in the row and unicuspids overlapping. Upper last premolar (pm^4) long as wide. The teeth thus differ conspicuously from the type usual to the naked-tailed species of the *dolichura* group and most resemble those of the forms in the *turba* group.

Measurements of type.— Total length, 125; tail vertebræ, 54; hind foot, 12 (dry, without claws, 11.6); ear, 9. Skull: Condylo-incisive length, 21.3; condylo-basal length, 20.6; greatest breadth, 9.5; maxillary breadth, 6.9; least interorbital breadth, 4.4; mandible, 11.8. Teeth: Entire upper row, 10; front of pm^4 to back of m^2, 5.4; entire lower row, 9.3.

The combination of dark color above and below, absence of long hairs on tail except at base, small hind foot, short braincase, and large, roundish unicuspid teeth, makes this species easy to recognize among the other shrews known from the region. The species evidently belongs in that group which includes *poensis* and *batesi*, and is not related closely to the other bare-tailed species from Medje. It is represented only by the type specimen.

6. **Crocidura jacksoni denti** *Dollman.*

Plate X, Fig. 2.

1915. [*Crocidura*] *j*[*acksoni*] *denti* Dollman, Ann. and Mag. Nat. Hist., Ser. 8, Vol. 15, p. 516. May. (Between Mawambi and Avakubi, Congo.)

Seventy-one specimens, including nine in alcohol, from localities as follows: Avakubi, 6; Babeyru, 1 in alcohol; Bafwabaka, 1; Faradje, 5; Gamangui, 2; Medje, 51; Nala, 3 in alcohol; Niangara, 2.

There are specimens in this fine series collected in nearly all the months of the year. As a consequence there is great diversity in color, the skins in the dark, fresh coat and those in the reddish stages of extreme wear contrasting greatly. Several very young examples show all the range of variation exhibited by the adults; the first juvenile coat evidently fades very rapidly. Owing to the great diversity of color shown in this series, I have given these specimens special study in an endeavor to divide them into two or more species, but have failed in this effort and am forced to consider them all of one form. The skulls of the oldest males are naturally somewhat larger than those of younger males and females, but after all the range of variation is no greater than in several species of shrews from British East Africa, represented in the National Museum by equally large series.

There is also some variation in the relative size of the second and third unicuspid teeth. This character certainly is not always a reliable one in species of *Crocidura* which have these teeth normally somewhat of the same size.

Specimens from the Uelle drainage appear paler than the average skins from the Ituri, but the pelages are not strictly comparable and the difference is slight.

The collectors note three pairs of inguinal mammæ. One female collected at Bafwabaka, December 29, contained two large embryos.

7. **Crocidura bicolor** *Bocage.*

1890. *Crocidura bicolor* Bocage, Jorn. Sci. Acad. Lisboa, Ser. 2, Vol. I, p. 29. (Gambos, Angola.)

A single very immature alcoholic specimen, with skull removed, from Avakubi. It apparently represents a form very much like *C. b. woosnami* Dollman from Lake Ngami; but it would be useless to attempt an exact subspecific determination. There is a faint stripe of brownish along the upper side of the otherwise whitish tail; the white bristle hairs are rather inconspicuous; hands and feet whitish.

8. **Crocidura oritis** sp. nov.

(Plate VII, Fig. 2; VIII, Figs. 2, 2*a*.)

Type, No. 48510, Amer. Mus. Nat. Hist., skin and skull of adult ♂ (basal suture closed; teeth moderately worn) collected at Avakubi, Ituri River, Belgian Congo, July 6, 1914, by Herbert Lang and James P. Chapin. Orig. No. 2530.

Related to *Crocidura maurisca* Thomas, but averaging less blackish brown in color, the underparts less richly colored, and the feet less blackish. Size about as in *maurisca*, but hind foot larger and skull more robust, with heavier teeth. Tail with long bristles only at base as in *maurisca* and allies.

Color.— Type: Upperparts grayish brown, or dark hair brown, finely speckled with lighter grayish; crown and face slightly darker, more blackish brown; underfur rather light slate gray. Hands and feet brownish buff, the feet darker along outer half from heel to toe. Tail uniformly dull blackish brown except near base below where there are a few lighter buffy hairs. Underparts mouse gray, uniformly colored from chin to tail except for an irregular wash of cinnamon buff. Side glands inconspicuous, about the color of the surrounding hair. No definite line of demarcation between color of upperparts and of belly, the two shades blending over the sides of the body.

Other specimens differ much in color from the type. A January skin from Medje matches the type most closely; an April skin is in very bleached pelage, with irregular patches of rusty red on the upperparts. Two other skins from Medje, June and September, are quite dark, more as in a very uniformly colored series of *maurisca* from the Victoria Nyanza region. These last two are, however, rather immature animals, with the basal suture still open.

Skull and teeth.— Skull larger than in *maurisca*, about the size of that of the closely related *C. littoralis* Heller from Butiaba, but slightly more robust in build and with wider maxillary processes, rostrum, and palate. Teeth essentially as in *littoralis* and *maurisca*, the unicuspids oval from crown view, with wide cingula and small cusps; last upper premolar, in unworn condition, longer than wide.

Measurements of type.— Total length, 159; tail vertebræ, 65; hind foot, 18 (dry, without claws, 16.6). Skull: Greatest length, 23.4; condylo-incisive length, 23.3, condylo-basal length, 22.6; greatest breadth, 10.2; maxillary breadth, 7.1; mandible, 12.1; upper tooth row, entire, 10.4; front of pm^4 to back of m^2, 5.3; lower tooth row, entire, 9.4.

This new species is based on five specimens, four from Medje and one from Avakubi. It is closely related to *maurisca* and *littoralis* but may be separated from either by the lighter color, greater maxillary breadth, and more robust teeth. The three forms, *maurisca, littoralis,* and *oritis,* probably form an intergrading chain of subspecies. They are readily distinguished from *Crocidura niobe* Thomas by the larger hind foot and the narrower unicuspid teeth.

9. **Crocidura latona** sp. nov.

(Plate VII, Fig. 3; VIII, Figs. 3, 3*a*.)

Type, No. 48610, Amer. Mus. Nat. Hist., skin and skull of adult ♂ (basal suture closed; teeth moderately worn) collected at Medje, Belgian Congo, March 17, 1910, by Herbert Lang and James P. Chapin. Orig. No. 773.

Related to *Crocidura niobe* Thomas, but much more brownish (not gray) in color, and with underparts scarcely lighter in color than back. Size about as in *niobe*. Tail thinly haired and with long bristles only at base. Fur of back short.

Color.— Type: Upperparts rich, glossy bister, the nose darker; underfur narrowly brownish gray at base. Underparts only slightly lighter brown than the back and sides; lateral glands russet. Hands and feet buffy brown, very thinly haired with brown. Tail above and below blackish brown, very slightly lighter at base below.

Skull and teeth.— Skull in size about as in *Crocidura niobe,* or slightly smaller; the general appearance much as in *maurisca* and *littoralis,* but decidedly smaller. Teeth distinctly of the *maurisca* and *littoralis* type (the unicuspids rather narrow with small cusps and large cingula) but second and third upper unicuspids wider and more inclined to be circular, as in *niobe.* Last upper premolar longer than wide.

Measurements of type.— Total length, 135; tail vertebræ, 59; hind foot, 14 (dry, without claws, 13.2); ear, 9. Skull: Condylo-incisive length, 19.8; condylo-basal length, 19.0; greatest breadth, 8.9; maxillary breadth, 6.1; mandible, 10.8; upper tooth row, entire, 8.7; front of pm^4 to back of m^2, 4.7; lower tooth row, entire, 8.2.

This species evidently is closely related to the Ruwenzori *Crocidura niobe,* but differs conspicuously from that species in its almost uniform dark brownish coloration, above and below. Besides the type there is a single skin, without skull, in the collection from Avakubi which is doubtless of the same form. It is an October specimen and is slightly more reddish brown than the type, with which it agrees in general dimensions.

10. **Crocidura ludia** sp. nov.

(Plate VII, Fig. 4; IX, Figs. 1, 1*a*.)

Type, No. 48566, Amer. Mus. Nat. Hist., skin and skull of adult ♂ (teeth slightly worn and basal suture not closed) collected at Medje, Belgian Congo, May 16, 1914, by Herbert Lang and James P. Chapin. Orig. No. 2366.

A small species related to *Crocidura muricauda* Miller and *C. dolichura* Peters, but coloration brownish, not gray, above and below. Tail shorter than in *dolichura* and skull smaller, with smaller teeth. Tail appearing naked but clothed with very short, inconspicuous hairs; a few longer bristles at extreme base.

Color.— Upperparts bister or mummy brown, uniformly colored from nose to tail; underfur smoke gray. Underparts hair brown, not conspicuously separated from color of sides and back. Feet very thinly haired, buff, with brown streak along outer side. Tail blackish brown above, lighter on basal third below.

Skull and teeth.— Skull like that of *Crocidura muricauda* but slightly larger, with greater interorbital breadth, wider, flatter braincase, and more slender rostrum; palate wider and shorter. Teeth slightly smaller than in *muricauda* or *dolichura,* but otherwise similar, with second and third unicuspids of about equal size or second rather smaller than third; unicuspids of the general *maurisca* type (oval in form, with small cusps and large cingula) though not so extreme as in *maurisca* or *littoralis;* last upper premolar longer than wide.

Measurements of type.— Total length, 120; tail vertebræ, 60; hind foot, 14 (dry, without claws, 12.7); ear, 9. Skull: Condylo-incisive length, 18.2; condylo-basal length, 17.5; greatest breadth, 8.2; maxillary breadth, 5.4; least interorbital breadth, 4.0; mandible, 9.2; upper tooth row, entire, 7.8; front of pm^4 to back of m^2, 4.0; lower tooth row, entire, 7.4.

Three specimens of this new species of *Crocidura* are in the collection — two from Medje and one from Ngayu. The topotype skin from Medje, a female, measures: Total length, 116; tail vertebræ, 53; hind foot, 12; ear, 9. The tail of the Ngayu skin is 57 millimeters in length. All agree almost precisely in coloration. The species apparently is close to *C. dolichura* but may be distinguished by its brown coloration and shorter tail.

The Liberian shrew described by Miller in 1900 as *Myosorex muricauda*[1] proves to be a species of *Crocidura*. It was transferred by Thomas[2] in 1904 from *Myosorex* to the genus *Sylvisorex*. Consequently Dollman does not include it in his recent revision of the African shrews of the genus *Crocidura*.[3] The species is closely related to *C. dolichura* and should have been placed between that species and *maurisca* in Dollman's synopsis. It is hard to understand how Thomas could have been misled by the excellent description and figures given by Miller.

11. **Crocidura polia** sp. nov.

(Plate VII, Fig. 5; IX, Figs. 2, 2*a*.)

Type, No. 48559, Amer. Mus. Nat. Hist., skin and skull of adult ♂ (basal suture closed; teeth moderately worn) collected at Medje, Belgian Congo, July 1, 1914, by Herbert Lang and James P. Chapin. Orig. No. 2442.

A small, grayish brown, long-tailed shrew with the general proportions of *C. dolichura* Peters, but with the tail heavily covered with short hairs which increase in numbers and length at the tip to form a distinct white brush. A few scattered longer bristle-hairs on basal third of tail. Skull and teeth much as in *dolichura*, *muricauda*, and *ludia*. Pelage moderately full, the hairs at middle of back about 3.5 millimeters in length.

Color.— Upperparts uniform grayish brown, or perhaps better described as pale fuscous with a faint sprinkling of silvery gray; sides and underparts distinctly lighter, more grayish, but not sharply marked from color of back; lateral glands drab. Hands and feet thinly coated with whitish hairs. Tail well coated with short hairs which increase in length and numbers on the terminal half and produce a distinct white pencil at tip; blackish brown above, slightly lighter below, especially at extremity, and tipped with white.

Skull and teeth.— The skull is remarkably like that of *Crocidura ludia*, just described above; is of about the same size and general shape, but has a slightly flatter braincase and less developed maxillary processes. It thus clearly shows the relationship with *dolichura* and *muricauda*. The teeth are essentially as in *ludia* but the unicuspids are slightly less oval, more roundish, and pm^4 is slightly less lengthened, about as long as wide. Second and third unicuspids about of equal size but third overlaps second and appears larger from a view of the crown surface.

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[1] Proc. Washington Acad. Sciences, Vol. 2, p. 645, December, 1900.

[2] Proc. Zool. Soc. London, 1904, p. 190.

[3] Ann. and Mag. Nat. Hist., Ser. 8, Vol. 15, pp. 508–527, May, 1915, et seq.

Measurements of type.— Total length, 130; tail vertebræ, 72; hind foot, 13; ear, 9. Skull: Condylo-incisive length, 18.2; condylo-basal length, 17.5; greatest breadth, 8.2; maxillary breadth, 5.2; least interorbital breadth, 3.8; mandible, 9.4; entire upper tooth row, 7.8; entire lower tooth row, 7.3.

The type and only specimen of this new species differs from all the African forms of *Crocidura* with which I am familiar by its combination of small size; long, hairy, penicillate tail, with longer bristle-hairs confined to near base and few in number; and teeth of the *dolichura* group type.

12. **Crocidura congobelgica** sp. nov.

(Plate VII, Fig. 6; IX, Figs. 3, 3*a*.)

Type, No. 48512, Amer. Mus. Nat. Hist., skin and skull of adult ♂ (teeth little worn) collected at Lubila, near Bafwasende, Belgian Congo, September 20, 1909, by Herbert Lang and James P. Chapin. Orig. No. 122.

A small, unicolored, dark brown shrew with long, black, naked tail. General external appearance much as in *Crocidura latona*, but skull widely different, more as in *Crocidura lutrella*, with large maxillary processes and rounded unicuspid teeth, the second and third of about equal size. Tail nearly naked except for scattered short, close-lying hairs and a very few longer bristles at base.

Color.— Entire head and body, above and below, rich, glossy bister; the lower sides and belly only very slightly lighter colored than the back. The upperparts are very finely streaked with cinnamon buff. Underfur, above and below, pale smoke gray. Whiskers long, mixed black and white. Hands and feet very thinly clothed with brown hairs, darker along outer sides. Tail dull brownish black except near extreme base below where it is slightly lighter.

Skull and teeth.— The skull differs from those of other members of the naked-tailed group in its comparatively great maxillary width. From above it greatly resembles skulls of the otherwise very different *C. lutrella* Heller of Lado. The first upper unicuspid is relatively larger, oval in crown pattern, with well developed cingulum; second and third unicuspids about equal in size, the third squarely posterior to, and somewhat overlapping, the second. In unworn condition these show the small cusps and large cingula characteristic of the group. The last upper premolar differs from that of other members of the group in its lack of conspicuous posterior emargination, the median space between it and the first molar being very small; the length of this tooth is about equal to its breadth, instead of much greater as usual in the group. From the skull of *C. latona* (which species this one most resembles in color and external characters) the skull of *C. congobelgica* may be separated readily by its larger size, much wider palate, stronger maxillary processes, and considerably larger teeth.

Measurements of type, followed by dimensions of an older adult female from Medje: Total length, 133, —; tail vertebræ, 59, —; hind foot, 14, 13. Skulls (the occiput of the type skull is damaged): Condylo-incisive length, —, 20.7; condylobasal length, —, 20.0; greatest breadth, —, 9.1; maxillary breadth, 7.0, 6.9; least interorbital breadth, 4.3, 4.2; palatal length, 8.9, 8.8; mandible, 10.7, 11.2; entire upper tooth row, 9.1, 9.3; front of pm^4 to back of m^2, 5.0, 5.0; entire lower tooth row, 8.4, 8.8.

There are only two specimens of *Crocidura congobelgica* in the collection, the type from Lubila and a specimen from Medje. Owing to the fact that these skins so closely resemble skins of *C. latona*, above described, it was with some hesitation that I decided to recognize by name two distinct species. Skulls of the two animals are so very different that no other course seems open. Though both obviously belong to the same group of bare-tailed species, the skull of the old adult male *latona* is much smaller than a younger female skull of *congobelgica*, and the other characters, as given above, point to certain specific difference between the two forms. The peculiar coloration is found, so far as I am aware, only in this group of species, and the long, black, almost hairless tail further instantly separates the two species from other shrews of the same general size.

13. **Sylvisorex gemmeus irene** *Thomas.*

1915. *Sylvisorex gemmeus irene* Thomas, Ann. and Mag. Nat. Hist., Ser. 8, Vol. 16, p. 151. August. (Kaganbah, Uganda.)

Eighteen specimens, including four young in alcohol, from Medje, and one specimen from Faradje.

Compared with skins of typical *gemmeus* from Lado, these specimens average considerably more brownish, less gray in color; but the forms are certainly very closely related and the skulls seem indistinguishable. The type locality of this subspecies is in southern Uganda, but Mr. Thomas has already recorded specimens from the Uelle and Ituri valleys.[1] The specimen listed above from Faradje is like those from Medje and shows no approach in color to the Lado form.

The collectors note three pairs of mammæ for this shrew. They found two large embryos in a female collected at Medje, January 18; and two medium sized embryos in a female from the same place on January 20.

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[1] Ann. and Mag. Nat. Hist., Ser. 8, Vol. 16, pp. 151 and 471, August and December, 1915.

MEASUREMENTS OF SPECIMENS OF *Sylvisorex gemmeus irene* FROM MEDJE.

Museum Number	Sex	Total length	Tail vertebræ	Hind foot, with claws	Ear	Skull: Greatest length	Condylobasal length	Maxillary breadth	Greatest breadth	Mandible	Upper tooth row, entire	Lower tooth row, entire	Condition of teeth
48584	♂	153	85	16	9	18.1	17.4	5.3	7.7	9.3	7.9	7.3	moderately worn
48590	♂	136	73	15	9	17.8	17.3	5.5	7.8	9.1	7.8	7.3	"
48591	♂	155	83	15	9	17.8	17.1	5.4	7.8	9.0	7.6	7.2	"
48598	♂	147	81	15	8	17.5	16.8	5.3	7.6	8.9	7.4	6.8	little worn
48599	♂	143	73	14	10	—	—	5.5	—	9.2	7.4	6.7	moderately worn
48600	♂	146	82	15	9	—	—	5.8	8.0	9.5	7.9	7.3	"
48585	♀	137	73	15	9	17.3	16.6	5.4	7.4	8.8	7.4	6.8	"
48586	♀	142	80	14	9	—	—	5.6	—	—	7.8	6.9	"
48589	♀	138	74	15	8	17.3	16.5	5.4	7.5	8.8	7.7	7.0	"
48595	♀	141	76	14	8	17.8	17.3	5.4	7.5	9.0	7.7	6.9	"
48596	♀	141	75	15	9	17.3	16.7	5.4	7.7	8.9	7.4	6.8	"
48597	♀	151	83	14	8	17.5	16.8	5.7	7.8	8.6	7.5	6.8	"

14. **Sylvisorex oriundus** sp. nov.

(Plate VII, Fig. 7; IX, Figs. 4, 4*a*; XI, Fig. 1.)

Type, No. 48554, Amer. Mus. Nat. Hist., skin and skull of adult ♀ (teeth little worn) collected at Medje, Nava River, Belgian Congo, May 20, 1914, by Herbert Lang and James P. Chapin. Orig. No. 2368.

A large, short tailed, short furred, dark bellied species related to *Sylvisorex morio* (Gray), but larger, with much larger hind foot.

Color.— Upperparts from nose to tip of tail dark olive brown, or, in certain lights, dark sepia; the underfur deep neutral gray. Lower sides and underparts slightly paler, dark grayish brown, very slightly lighter on throat. Tail slightly darker than body above, lighter brown on basal two-thirds below. Hands and feet light buffy brown, the ankles blackish.

Skull and teeth.— Skull larger than in *S. morio*, with longer tooth row. Compared with the figure of the dentition of the type specimen of *S. morio*,[1] the second upper unicuspid tooth is relatively much smaller; the front face of the large cusp of pm^4 is much less sloping, the heel of this tooth smaller, and the anterior cusp, though little worn, is not more than half the height of the last unicuspid. The whole dentition is, except for the small size of the anterior cusp on pm^4, and the presence of two conspicuous notches on the anterior mandibular tooth, exceedingly like that of the much smaller *S. johnstoni* (Dobson) as figured on plate 28 of the Monograph of the Insectivora.

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[1] Dobson, Monog. Insect., pl. 25, fig. 2.

Measurements of type.— Total length, 134; tail vertebræ, 62; hind foot, 18; ear, 8. The hind foot in the dry skin, without claws, measures 16. Skull and teeth: Condylo-incisive length, 20.5; condylo-basal length, 19.9; maxillary breadth, 5.9; least interorbital breadth, 4.2; mandible, 11.1; entire upper tooth row, 8.9; front of pm^4 to back of m^2, 4.4; entire lower tooth row, 8.4. The skull is badly damaged in the braincase, but has been repaired so that the measurements as given are virtually exact.

There is only a single specimen of this large *Sylvisorex* in the collection. From the other species found at Medje, *Sylvisorex gemmeus irene,* it is readily distinguished by its large size, short tail, and dark colored belly. Thomas has recorded *Sylvisorex morio* from Medje[1] on the basis of a single immature specimen. The species represented may be the one here described.

15. **Scutisorex congicus** *Thomas.*

Plate XI, Fig. 2.

1915. *Scutisorex congicus* THOMAS, Ann. and Mag. Nat. Hist., Ser. 8, Vol. 16, p. 470 December. (Medje, Congo.)

Thirty-seven specimens from Medje and one from Bafwabaka.

This genus heretofore was known only from two examples, the type specimens of *Scutisorex somereni* and *S. congicus,* both described by Thomas since 1910. The Medje specimens are topotypes, the species *congicus* having been named from a specimen collected at that place by Dr. Cuthbert Christy in April, 1914.

There is considerable variation in color shown by the specimens in this series. On some skins there is very little rusty coloration while in others the entire body is suffused with buff and reddish brown. There is no very great variation in size among fully adult examples, as shown by the accompanying table of measurements. The lambdoid crests frequently project beyond the level of the condyles as described of *S. somereni.* The characters given by Thomas in separating this form from the Uganda species thus prove to be mostly individual differences. The two forms are doubtless very closely allied, but no specimen in the present series is quite so large as the type of *somereni.*

This series contains specimens of all ages from very young, showing the milk dentition, to old adults. The collectors record the mammæ as two pairs of inguinal; and the stomach contents of one adult male as several caterpillars.

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[1] Ann. and Mag. Nat. Hist., Ser. 8, Vol. 16, p. 471, December, 1915.

In making up the following table there were measured only specimens fully adult, the skulls with the basal sutures tightly closed.

MEASUREMENTS OF ADULT SPECIMENS OF *Scutisorex congicus* FROM MEDJE.

Museum Number	Sex	Total length	Tail vertebræ	Hind foot with claws	Ear	Skull: Condylobasal length	Greatest length	Greatest breadth	Maxillary breadth	Least interorbital breadth	Length of mandible	Upper tooth row, entire	Front of pm^4 to back of m^2	Lower tooth row
48453	♂	218	84	23	15	28.9	30.3	12.9	8.9	6.7	16.7	13.4	6.3	12.3
48455	♂	234	95	23	16	31.2	32.4	13.8	9.9	7.0	17.6	14.1	6.9	13.2
48458	♂	237	85	23	13	31.3	32.1	14.0	9.2	6.9	17.9	13.5	6.8	12.7
48462	♂	231	93	23	15	30.8	31.6	13.2	9.1	6.7	17.3	13.8	7.1	13.1
48464	♂	217	94	22	15	30.8	31.7	13.9	9.4	6.9	17.6	13.8	7.0	13.0
48465	♂	210	85	25	14	30.1	31.6	13.9	9.1	6.8	17.3	13.6	6.5	12.5
48473	♂	236	96	20	15	31.1	32.7	14.3	9.7	6.9	17.7	14.3	7.1	13.3
48474	♂	238	92	24	15	31.3	32.8	14.2	9.7	6.8	17.9	14.3	7.1	13.1
48487	♂	220	88	21	15	29.9	31.1	13.7	9.4	7.1	16.7	13.3	6.6	12.6
48488	♂	232	90	23	17	30.8	32.1	14.2	9.6	6.9	17.3	13.7	7.0	12.7
48451	♀	218	76	27	15	29.5	31.2	13.2	9.3	6.4	17.5	13.7	7.2	12.7
48471	♀	206	83	22	14	29.7	30.9	13.4	9.3	6.6	17.2	13.8	7.1	13.0
48480	♀	205	81	23	12	29.3	30.9	13.4	9.1	6.2	16.7	13.7	6.8	12.6
48482	♀	226	92	24	12	31.0	32.3	13.7	9.2	6.7	17.6	13.4	6.8	12.7
48486	♀	243	95	23	16	31.9	33.2	13.7	9.7	7.2	18.3	14.5	7.1	13.5
48503	♀	—	—	—	—	30.6	31.9	14.1	9.5	6.5	17.8	14.0	6.8	13.1

EXPLANATION OF PLATES.

PLATE VII.

(Natural size.)

Fig. 1. *Crocidura caliginea.* Type. 48555.
2. *Crocidura oritis.* Type. 48510.
3. *Crocidura latona.* Type. 48610.
4. *Crocidura ludia.* Type. 48566.
5. *Crocidura polia.* Type. 48559.
6. *Crocidura congobelgica.* Type. 48512.
7. *Sylvisorex oriundus.* Type. 48554.

PLATE VIII.

(Five times natural size.)

Figs. 1, 1a. *Crocidura caliginea.* Type. 48555.
2, 2a. *Crocidura oritis.* Type. 48510.
3, 3a. *Crocidura latona.* Type. 48610.

PLATE IX.

(Five times natural size.)

Figs. 1, 1a. *Crocidura ludia.* Type. 48566.
2, 2a. *Crocidura polia.* Type. 48559.
3, 3a. *Crocidura congobelgica.* Type. 48512.
4, 4a. *Sylvisorex oriundus.* Type. 58554.

PLATE X.

Fig. 1. *Crocidura nyansæ kivu* Osgood. (About $\frac{3}{5}$ natural size.) ♂ ad., No. 48501. Medje, June 13, 1914. Photo by Herbert Lang.

2. *Crocidura jacksoni denti* Dollman. (Slightly reduced.) ♀ ad., No. 48520. Medje, May 28, 1914. Photo by Herbert Lang.

PLATE XI.

Fig. 1. *Sylvisorex oriundus* Hollister. Type. (Almost natural size.) ♀ ad., No. 48554. Medje, May 20, 1914. Photo by Herbert Lang.

2. *Scutisorex congicus* Thomas. (About $\frac{1}{2}$ natural size.) ♂ ad., No. 48475. Medje, May 30, 1914. Photo by Herbert Lang.

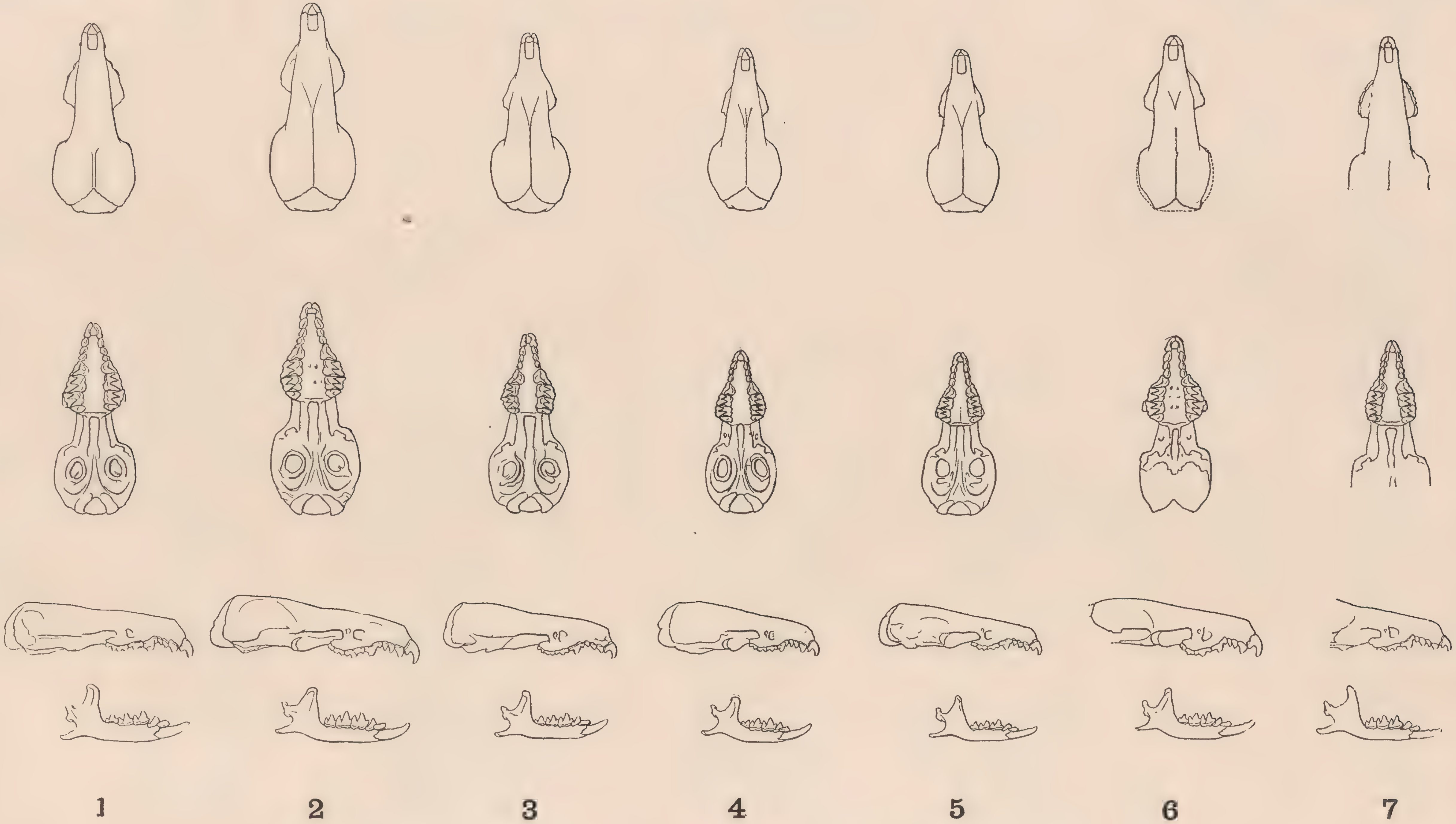


Fig. 1. Crocidura caliginea.
" 2. " oritis.
" 3. " latona.
" 4. " ludia.

Fig. 5. Crocidura polia.
" 6. " congobelgica.
" 7. Sylvisorex oriundus.

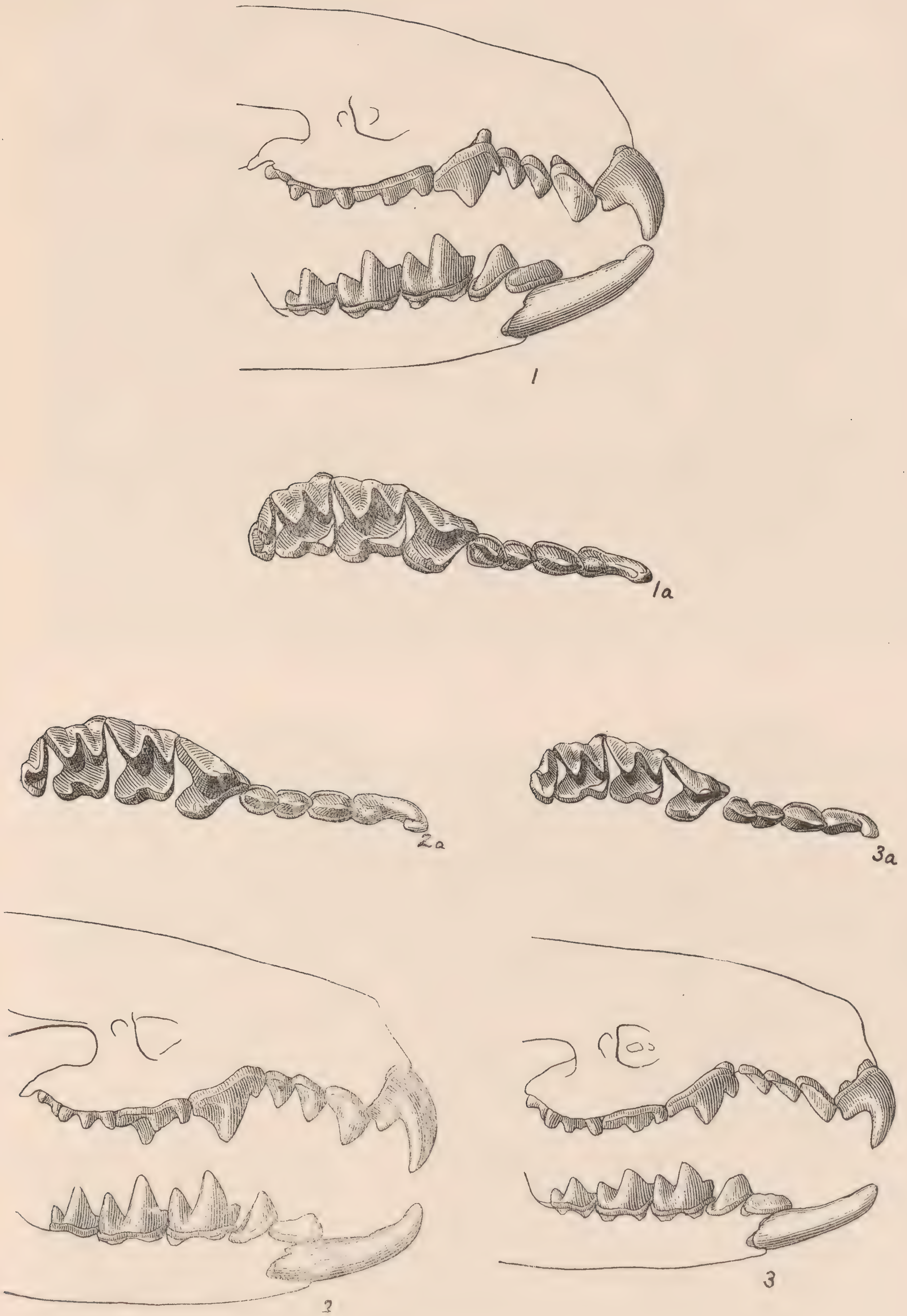
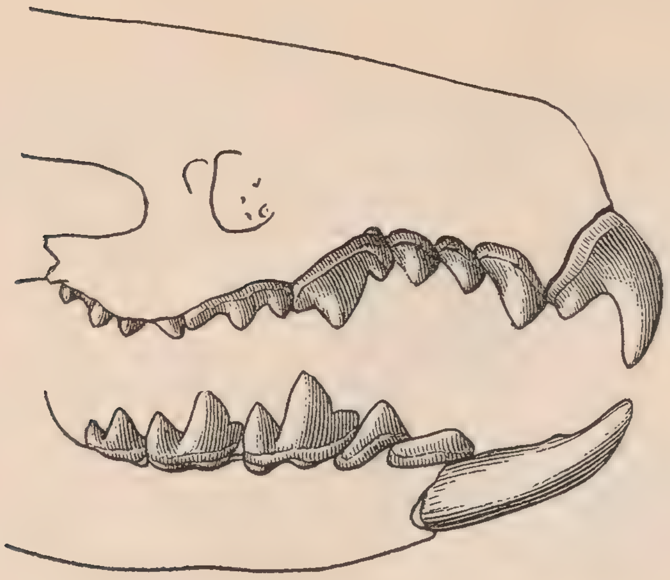
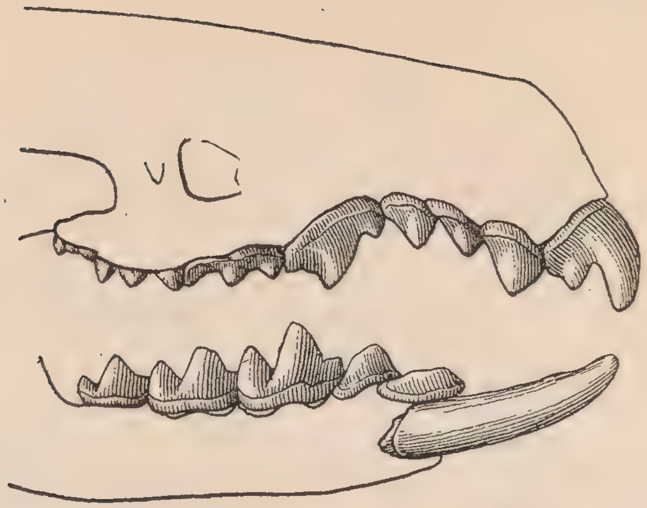
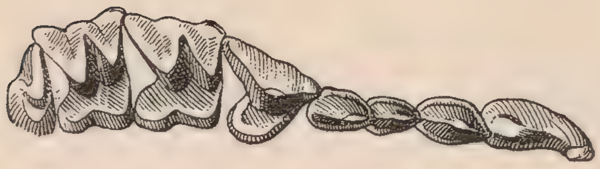


Fig. 1. Crocidura caliginea.
Fig. 2. " oritis.
Fig. 3. " latona.

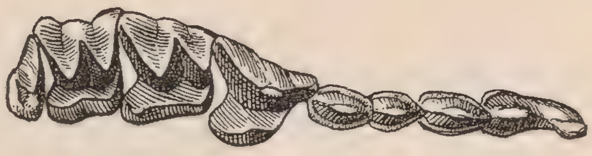




2



1a



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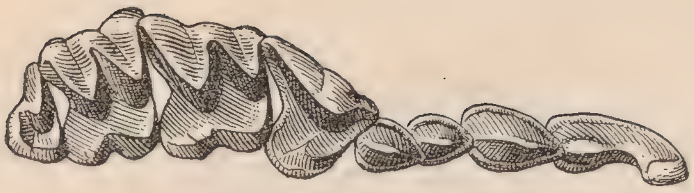
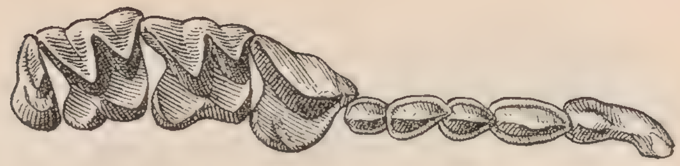
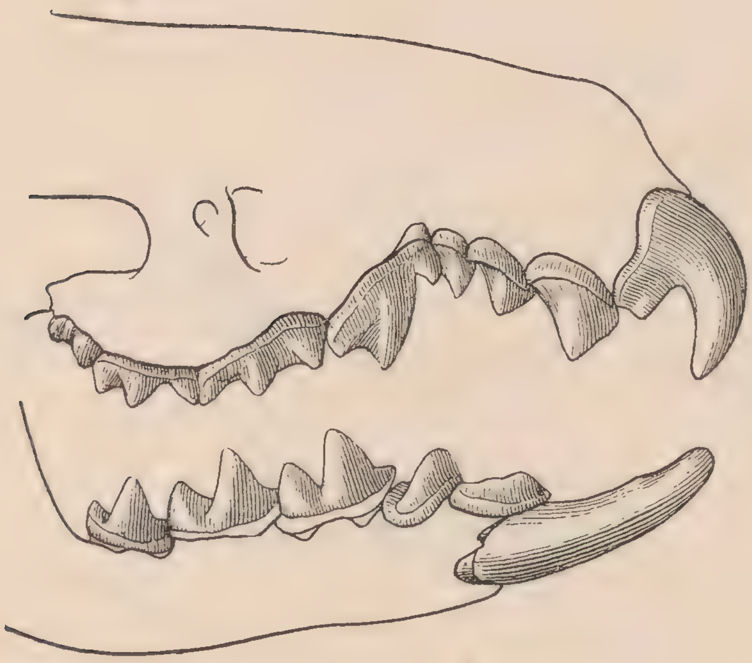


3a



4a



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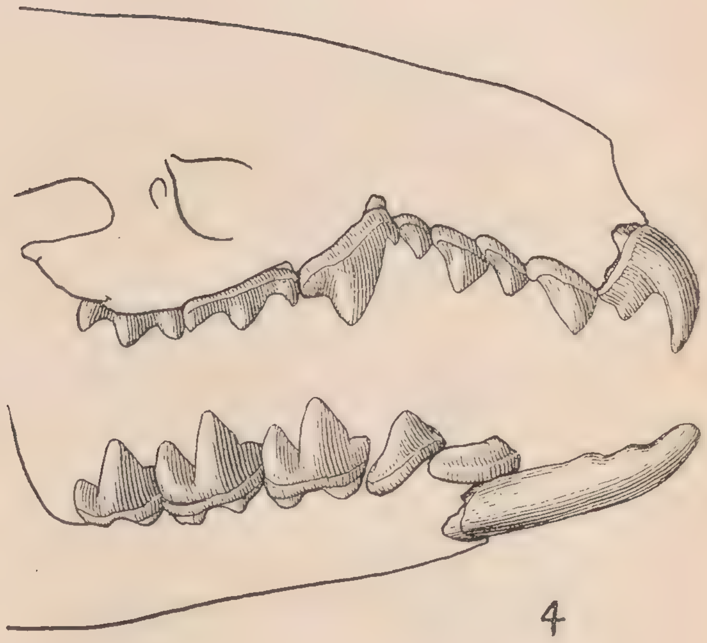
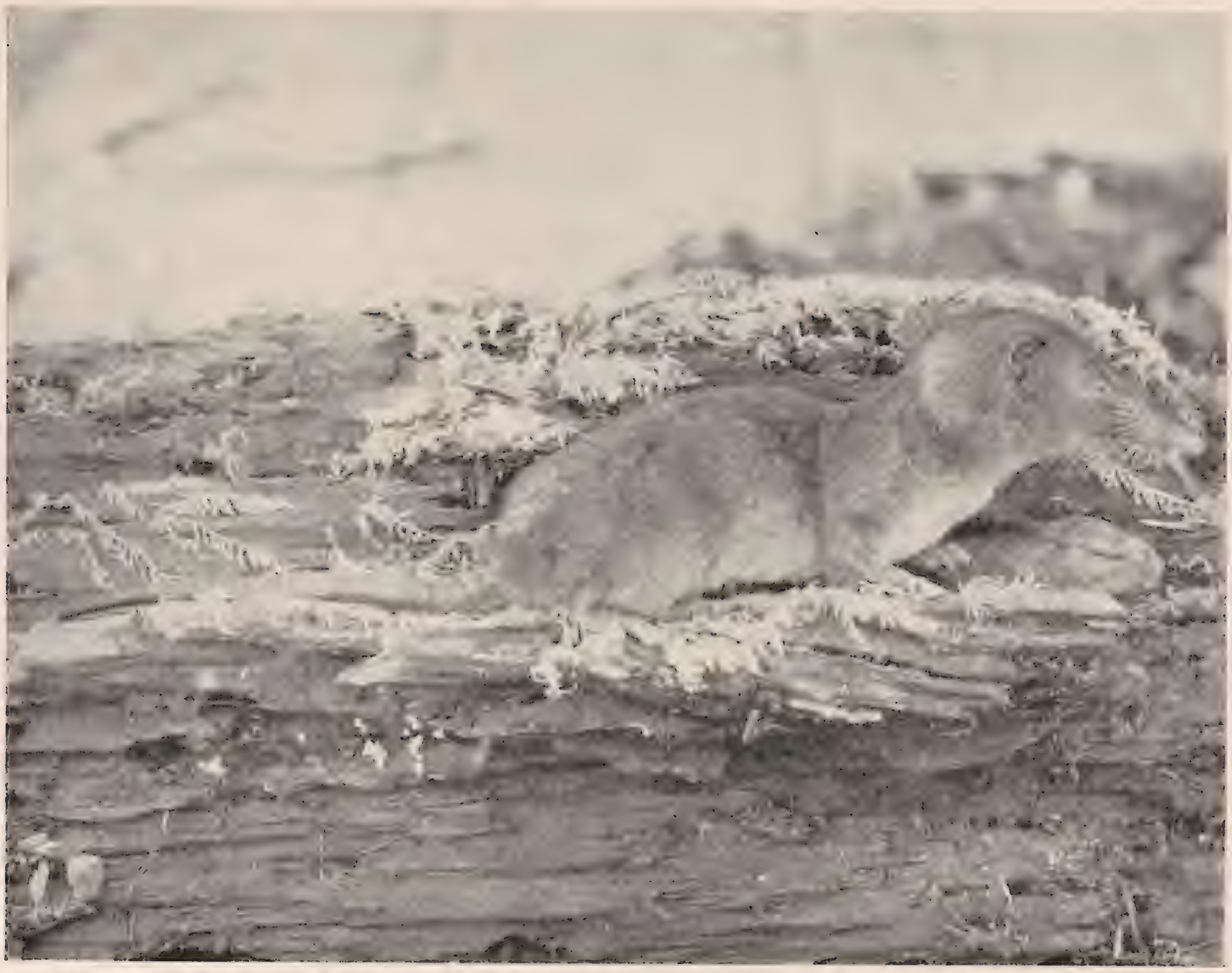


4

Fig. 1. Crocidura ludia.
" 2. " polia.

Fig. 3. Crocidura congobelgica.
" 4. Sylvisorex oriundus.



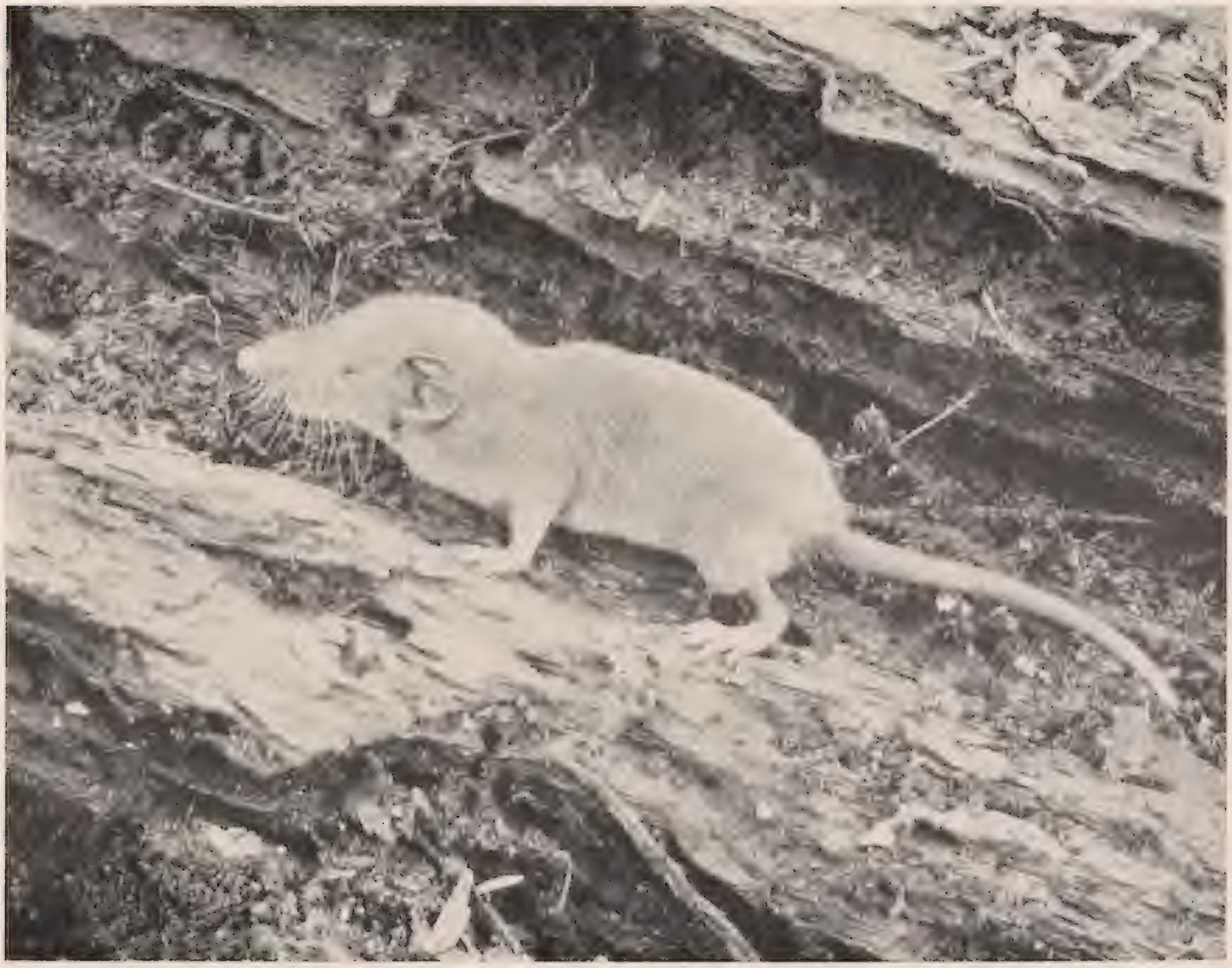
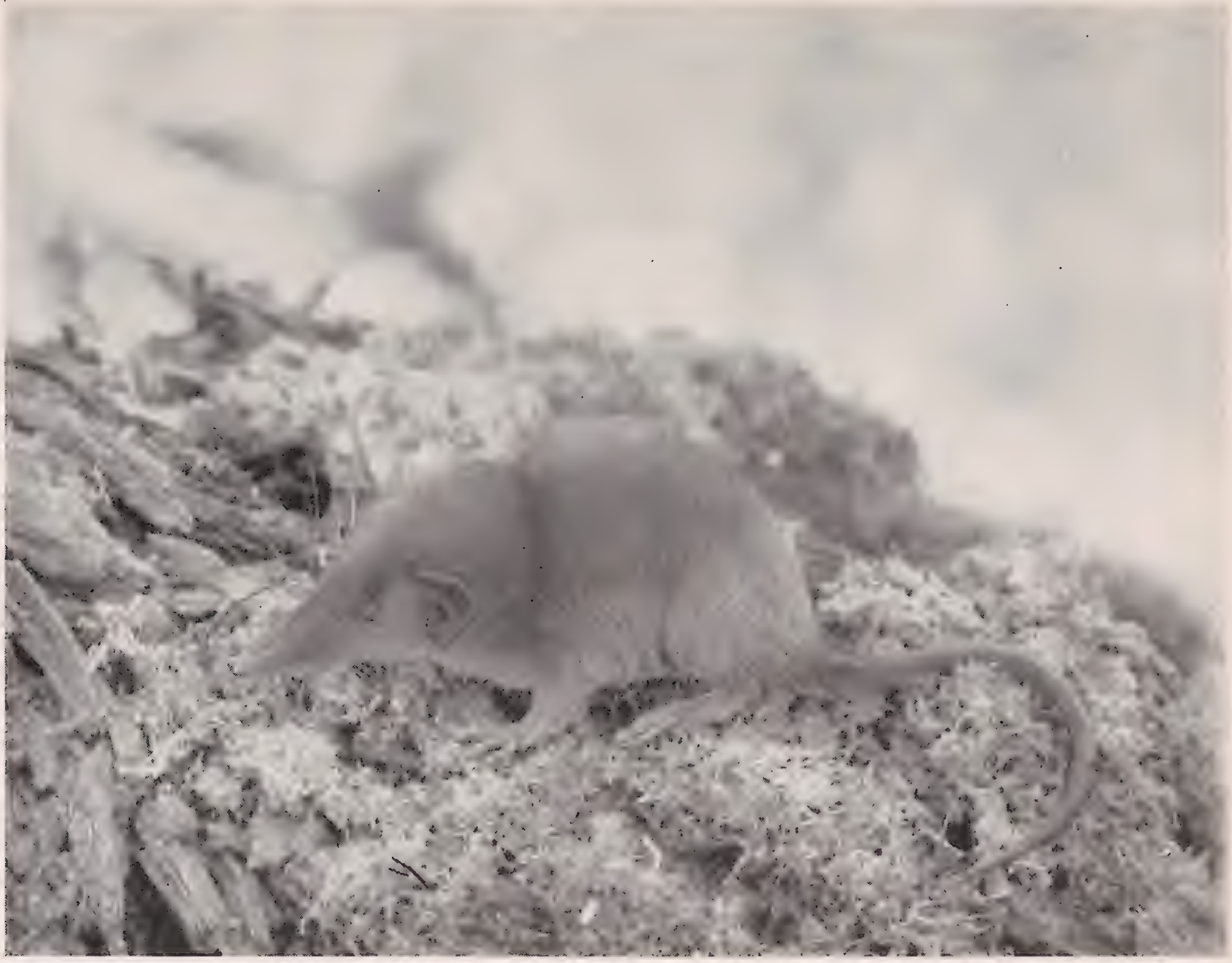


Fig. 1. *Crocidura nyansæ kivu* Osgood.
Fig. 2. *Crocidura jacksoni denti* Dollman.



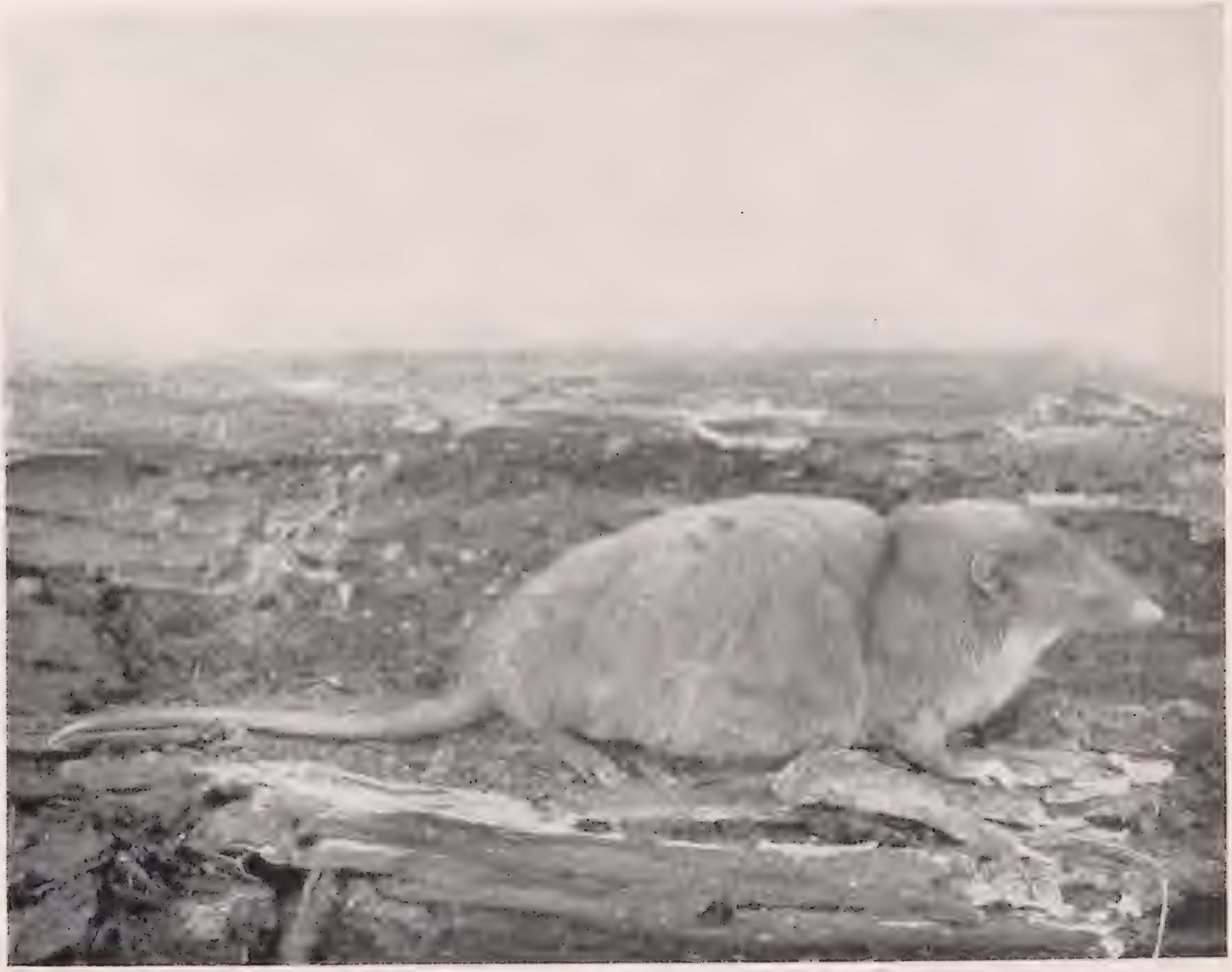


Fig. 1. *Sylvisorex oriundus* Hollister.
Fig. 2. *Scutisorex congicus* Thomas.

59.57,62C(729)

Article XXXVI.—DESCRIPTIVE CATALOGUE OF WEST INDIAN CICINDELINÆ.[1]

By Charles W. Leng and Andrew J. Mutchler.

Plate XII.

The material now accumulated in this Museum by the expeditions to Cuba, Santo Domingo, Porto Rico, Jamaica and many islands of the Lesser Antilles, in conjunction with that found in several public and private collections, permits of a fairly complete view of the coleopterous fauna of the West Indies, subject, however, to the difficulties of mounting and identifying thousands of specimens. In the Cicindelinæ the interest that these graceful and brightly colored beetles always excite has led to the records being especially copious; and besides, we have had the advantage of access to the remarkable collection of Mr. Edward Doubleday Harris, as well as the aid of the nearly complete bibliography contained in Dr. Walther Horn's work in Genera Insectorum. It is gratifying to find that the Museum collections add materially to the published statements regarding the distribution of the described species and even to their number; and, while we recognize the lack of data from many of the smaller islands, which have not been exhaustively studied, we feel that our knowledge of the subfamily enables us to state approximately its history in the West Indies.

The table below indicates a dispersal of the genus *Cicindela* from the United States to Cuba, Porto Rico and Hispaniola, with a decreasing number of species as we proceed southward; accompanied, however, by a dispersal of one species (*suturalis*) in the opposite direction, from South America northward. The southward dispersal apparently ceases at Guadeloupe, the northward reaches Porto Rico; but additional data may alter these statements.

Table of known Distribution of genus Cicindela in the West Indies.

Florida	19	species	including 3-fasciata, marginata.
Bahamas	2	"	3-fasciata, marginata.
Grand Cayman	1	"	3-fasciata.
Cuba	7	"	boops, olivacea, 3-fasciata, cubana, cardini, viridicollis, marginata.
Porto Rico	3	"	boops, 3-fasciata, suturalis.
Hispaniola	3	"	boops, 3-fasciata, suturalis.

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[1] The following new names are proposed in this paper: viz., *Cicindela cubana* n. sp., *Cicindela cardini* n. sp., *Tetracha carolina* var. *floridana* n. var., *Tetracha sobrina* var. *antiguana* n. var.

St. Thomas	2	species,	3-fasciata, suturalis.
Guadeloupe	3	"	3-fasciata, suturalis, argentata.
Antigua	2	"	3-fasciata, suturalis.
Jamaica	1	"	3-fasciata.
Barbuda	2	"	3-fasciata, suturalis.
Martinique	1	"	suturalis.
St. Bartholomew	1	"	suturalis.
Grenada	1	"	suturalis.
St. Vincent	1	"	suturalis.
Barbados	1	"	suturalis.

We have also a dubious record of *dorsalis* in Cuba, which, if authentic, would add to the West Indian-Floridian relationship; and an ancient and probably erroneous record of *rufiventris* in Haiti.

It may also be said that the table exhibits, in the comparatively large number of peculiar Cuban species, the same tendency to Antillean individuality that was referred to in our Preliminary List as exemplified by such genera as *Leucocera, Exophthalmus* and others not there mentioned, like *Solenoptera* and *Pseudomus.*

The isolated occurrence of *argentata* in Guadeloupe, a species thus far unknown from the islands between Guadeloupe and South America, where it is abundant in many varieties, is interesting and at present, not easily explained.

SYSTEMATIC POSITION OF ANTILLEAN CICINDELINÆ.

According to Dr. Walther Horn's recent work in Genera Insectorum, the Cicindelinæ constitute a subfamily of the Carabidæ, themselves the principal division of the series Adephaga, the predaceous land beetles; and are capable of subdivision as follows:

	Alokosternal Division.
Tribe Ctenostomini	Madagascar, Tropical America.
" Collyrini	Southern Asia to No. Queensland.
	Platysternal Division.
" Mantichorini	Southern Africa.
" Megacephalini	
Subtribe Platychilina	Southern Africa.
" Omina	Pacific Coast and Sonoran Region.
" Megacephalina	
Genus *Eucallia*	Equador, Columbia.
" *Oxychila*	Tropical America.
" *Chiloxia*	Equador, Bolivia, Guiana.

Genus *Pseudoxychila*	Andes Chain from Costa Rica to Bolivia.
“ *Aniaria*	Northern South America.
“ *Megacephala*	Tropical and Temperate Regions.
Tribe Cicindelini	
subtribe Dromicina	Tropical Regions.
“ Theratina	“ “
“ Prothymina	“ “
“ Odontochilina	“ “
“ Cicindelina	Tropical and Temperate Regions.

Of these subdivisions (notwithstanding that many abound in northern South America, reaching even to Trinidad, where four species of *Odontochila* occur) only two, both of which attain the temperate regions, Megacephalina and Cicindelina, are found in the West Indies. The list of species, so far as known, with their distribution outside the West Indies is as follows:

Tribe Megacephalini.
Subtribe Megacephalina.
Group Tetrachæ.
Genus *Tetracha*.

carolina	U. S. and Antilles.
acutipennis	peculiar to Antilles.
sobrina var. *infuscata* and var. *antiguana*	“ “ “

Tribe Cicindelini.
Subtribe Cicindelina.
Genus *Cicindela*.

3-fasciata	U. S. and Antilles.
marginata	“ “ “
boops	peculiar to Antilles.
olivacea	“ “ “
viridicollis	“ “ “
cardini	“ “ “
cubana	“ “ “
suturalis	South America and Antilles.
argentata	“ “ “ “

This table again exhibits the strong relationship with North America, the more feeble relation with South America, and the development of peculiar Antillean forms. It is noteworthy that the characteristic Odontochilina, *Oxychilæ*, etc., of northern South America have not extended beyond Trinidad; while the Cicindelinæ of the more temperate North American mainland have become established in the Greater Antilles and have there developed several peculiar species. It may be further remarked that the habits of the most widely distributed species, *C. trifasciata*, make its haunts and larval home those shores whereof portions would be liable to disintegration by waves and storms, so that ocean drift would be more likely to aid in distribution than in most instances.

We are indebted to Mr. Gilbert J. Arrow for a memorandum of the distribution of Cicindelæ in the British Museum and to Mr. E. A. Schwarz for aid in examining the specimens in the U. S. National Museum.

Genus **Tetracha** *Hope.*

The genus *Tetracha* is represented by numerous closely related species in tropical America and extends northward to Washington, D. C.; Cincinnati, O., where it has been noted as numerous under electric lights by Dury; and even to Long Island, N. Y., where a single specimen has been found by Davis. Of the Antillean species: *acutipennis*, most sharply differentiated by its separately pointed elytra, is confined to Cuba and Hispaniola, so far as known; *sobrina* ranges from South America through the Lesser Antilles to Porto Rico, exhibiting differences of color in the various islands; while the third species, *carolina*, widely distributed in the more southern parts of the United States, Mexico and Central America and breaking into many varieties in its extended range, is thus far known only from Cuba and Grand Cayman.

Key to Antillean Species of Tetracha.

1. Elytra separately acuminate at apex . . . . *acutipennis*.
   Elytra rounded at apex 2
2. Punctures of elytra coarse, forming transverse rugæ especially in basal half, and muricate; apical lunules broad throughout, enclosing an extension of the dark color which is sub-triangular in outline and pointed at apex 3
   Punctures of elytra finer, scarcely confluent at base, widely separated behind the middle, nowhere muricate; apical lunules usually narrower apically, enclosing an extension of the dark color which is rarely triangular or pointed, but usually broady rounded at apex 4
3. Elytra coppery bronze in color, with green reflections, but largely suffused with black in form of letter V . . . . *sobrina*.
   Elytra not suffused with black . . . . var. *antiguana*.
   Elytra not coppery in color, greenish bronze largely suffused with black. var. *infuscata*.
4. Elytra coppery suffused slightly with black over a small area in front of the lunules 5
   Elytra not coppery but greenish bronze largely suffused with black; femora in part and first three antennal joints dusky . . . . var. *floridana*.
5. Legs and antennæ usually testaceous . . . . *carolina*.
   Outer part of hind femora and apex of first three antennal joints usually darker in color . . . . var. *occidentalis*.

Tetracha acutipennis *Dejean.*

Plate XII, Fig. 1.

(The bibliography and synonymy of this and following species will be found in Genera Insectorum, fasc. 82A, 82B, 82C, where, however, the references from Duval and Gundlach are omitted).

Occurs in Cuba (Gundlach, Coleop. de Cuba, p. 9, 1891; Duval, in Sagra's Hist. Phy. Po. Nat. Cuba, Anim. Artic., 1857, p. 4) and in Hispaniola. At once distinguished by the form of the elytra each of which ends in a short, sharp point, the two together making a triangular incision at the sutural apex. The color is greenish bronze, largely suffused with black, or the dark color may predominate (*cyaneo-nigra* Chaudoir Mss. according to labels on specimens in Harris Coll. received from Staudinger by the late A. Luetgens); the legs, the antennæ and the apical lunules are testaceous; the lunules broad, meeting at sutural apex and enclosing a triangular extension of the dark color. The first three joints of the antennæ are tipped with fuscous, and the extremities of the hind femora are usually dusky. Length, 11 to 12 mm.

Represented by a specimen identified by Dr. W. Horn and donated by Mr. Edw. D. Harris and by a series from Hispaniola in his collection derived from the Speyer and the Luetgens Coll.

Tetracha sobrina *Dejean.*

Occurs from Mexico to Colombia and in St. Bartholomew (?).

The head and thorax are coppery with greenish reflection on the front of the former and flanks of the latter; elytra coppery with greenish reflection, broadly suffused with black extending in a V-shaped mark from humeri nearly to apex, apical lunules broad throughout; a broad triangular spot on the disk enclosing the lunule ascending to about the basal third. Length, 14–15 mm.

This species can usually be distinguished from *carolina* by the broad apical lunules with the inner margin but slightly sinuate so that the extension of the dark area is subtriangular, but where this fails, the extremely coarse punctuation of the elytra will be decisive.

There are no specimens of this species in the Museum collection from the West Indies.

Tetracha sobrina var. **infuscata** *Mann.*

Plate XII, Fig. 2.

Occurs in Hispaniola, St. Thomas, Santa Cruz, Porto Rico, St. Bartholomew. It does not occur in Cuba, according to Gundlach (l. c., p. 10 and Anales de la Soc. Esp. de Hist. Nat., II, p. 290, 1894).

The color of the variety *infuscata* is similar to that of *acutipennis* but the tips of the elytra are almost conjointly rounded. The sculpture of the elytra is the same as of *sobrina* but the apical lunules are narrower. Length, 13–14 mm.

Represented by a specimen from Hispaniola, identified by Dr. W. Horn and donated by Mr. Edw. D. Harris, by specimens from Santa Cruz in Harris Coll., and by specimens in the Museum collection taken at Ensenada, Porto Rico, June, 1915, by Lutz and Mutchler, and at San Juan, Porto Rico, Aug. 2, 1914, by H. G. Barber. These are brighter in color than Hispaniola and Santa Cruz specimens but lack the coppery hue characteristic of var. *antiguana.*

Tetracha sobrina var. **antiguana**, new var.

Head and thorax as in *sobrina;* elytra coppery with greenish reflection but devoid of the black suffusion ascribed by description to *sobrina* and the dark portion enclosing the apical lunule does not ascend as far towards the base of the elytra. Length, 15–16 mm.

Under stones at edge of brackish marsh, St. John, Antigua, June 5, 1911 (R. W. Miner).

Tetracha carolina *Linné.*

Occurs in Cuba (Duval, *l. c.*, p. 3; Gundlach, *l. c.*, p. 9). On the mainland of America it ranges from Virginia to Nicaragua and, including varieties, even to Peru.

The form occurring in the Carolinas, and therefore probably the form described by Linné, has the legs and antennæ entirely testaceous; the name *carolina* belongs especially to this form but has been extended to include the slightly differentiated forms occurring in the States adjacent to Mexico, in which the femora in part and the tips of the first three antennal joints are sometimes darker in color. Such forms approach the Mexican variety *mexicana* and are perhaps identical therewith. In the West Indian forms similar differences in the color of the legs and antennæ are observed and the variety *occidentalis* cited below is based thereon. In the Carolinas, however, whence typical *carolina* was described, such differences are unknown and we therefore restrict the name for our present purpose to specimens with entirely testaceous legs and antennæ.

Apart from the color of the legs and antennæ, true *carolina* is of a brilliant metallic green hue with strong coppery reflections on the elytra and but very little suffusion of black in front of the lunules. The latter are broad in front, narrower behind, so that the enclosed extension of dark color is broad, subparallel rather than subtriangular, and rounded at apex. There is much variation in this character and specimens have been seen which could not be distinguished from *sobrina* by this character alone. As stated above, there is a constant difference in the punctuation of the elytra, which in *carolina* is distant, not muricate, and never forms transverse wrinkles. Length, 13–15 mm.

Represented by specimens collected on San Carlos Estate, Guantanamo, Cuba, October, 1913, by Mr. Charles T. Ramsden, in which the dark color of the legs is not at all apparent and the tips of the first three antennal joints are barely fuscous.

Tetracha carolina var. **occidentalis** *Klug.*

Occurs in Cuba (Duval, *l. c.*, p. 3 and Gundlach, *l. c.*, p. 9) and is probably the common form there, and in Grand Cayman (Harris Coll.).

As intimated above, this variety, though treated as a synonym by Dr. W. Horn in Genera Insectorum, is readily distinguished by the dark color of the tips of the first three antennal joints, the darker femora, especially towards the knees, and the greater extent of the area of the elytra suffused by black. The coppery reflections are, however, preserved. Length, 14–15 mm.

While the differences between the Cuban variety and typical *carolina* are confined to the coloration, they are apparently as great as those separating the Mexican varieties and the name for the Cuban variety should be retained as long as that of the Mexican variety is retained to avoid a false implication of climatic influence operating in the one region and not in the other.

Represented in the Harris Collection by specimens from Guantanamo and others without exact locality from Staudinger; also by specimens from Grand Cayman, May, 1911 (Lambert) and in the Museum Collection by specimens from vicinity of Havana, July (Cook); Vinales, Sept. (Lutz and Leng) and Santiago (donated by Mr. E. D. Harris).

Tetracha carolina var. **floridana**, n. var.

Occurs in southern Florida.

In this variety the coppery reflections of the elytra disappear almost entirely, a few specimens showing a bare trace behind the scutellum. The dark color of the legs and antennæ is faintly seen in a few specimens but generally these parts are testaceous as in true *carolina*. The elytra are, however, broadly suffused with black. In punctuation, shape of lunule, size and shape, this form agrees with *carolina*. Length, 14–15 mm.

Represented by the type in A. M. N. H. Coll. from Everglade, Fla., June, 1912, collected by the sons of Mr. Geo. W. Storter and donated by Mr. Wm. T. Davis, in whose collection and those of Messrs. Harris and Leng are other examples.

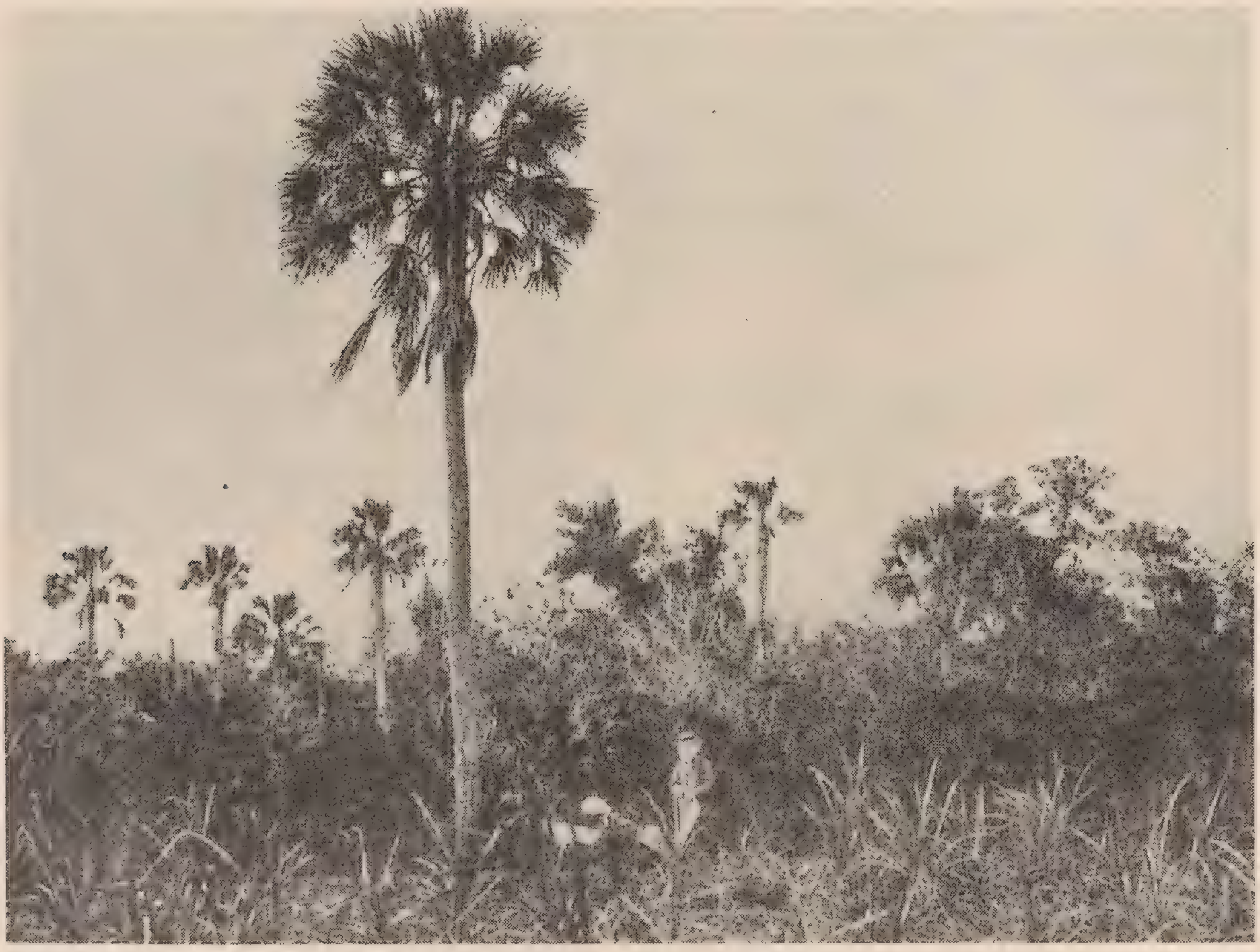

Fig. 1. Vicinity of Everglade, Fla. *Tetracha floridana* was taken here, but in open spots not shown in the photograph.

Specimens of this insect were sent by Mr. Harris to Dr. W. Horn and returned as var. *chevrolatii* under which name it appeared in "Carabidæ of Florida." It resembles *chevrolatii* in the dark color of the elytra, but differs in the paler color of the legs and antennæ, in its smaller size, and in the form of the apical lunules, which are less sinuate internally. *Chevro-*

latii being described from Yucatan, a false idea of distribution is involved in announcing its occurrence in Florida, and, slight as the differences are, we feel that for accurate representation of distribution, a name is required for the south Florida insect, which differs from the already described forms of *carolina* as much as they differ between themselves.

It may be noted that we have no dates for any species of *Tetracha* earlier than May. As Mr. Davis failed to find any species of the genus at Everglade during his visit to that locality, and his collector found *floridana* abundantly after his departure, there seems good reason to regard the genus as somewhat restricted in season.

Genus **Cicindela** *Linné.*[1]

Most of the species of *Cicindela* are insistent upon an environment peculiarly adapted to the inherited habits of their race and often become thereby restricted in their range to isolated areas of suitable character. The sea beaches, the mud flats adjoining them, inland sandy paths and open fields partly overgrown, each have their habitués the world over. We have endeavored, by inserting photographs of their haunts, to show the preferences of some of the West Indian species.

Synoptic Table of Antillean Species of Cicindela.

1. Elytra similar in both sexes, not emarginate near apex in either sex; mandibles toothed laterally but not beneath; sides of the head not pubescent........2
   Elytra dissimilar in sexes, emarginate near apex; mandibles toothed beneath as well as laterally; sides of head pubescent. (Ellipsoptera Dokturoh.) *marginata.*
2. Four front trochanters with erect setæ; markings normal..................3
   Two front trochanters with; two middle trochanters without, erect setæ; markings normal..................6
   Trochanters without setæ, elytra each marked with a whitish submarginal vitta. *cardini.*
3. Femora with hooked hairs..................5
   Femora without hooked hairs..................4
4. Elytral markings connected by white marginal stripe..................*boops.*
   Elytral markings all separate..................*olivacea.*
5. Elytra dark greenish bronze with normal markings except middle band is tortuous..................*trifasciata.*
   Elytra white with bronze markings..................*suturalis.*
6. Elytra with subsutural row of large foveæ..................*cubana.*
   Elytra without subsutural row of large foveæ..................7
7. Thorax brilliantly green..................*viridicollis.*
   Thorax not green; elytral markings all separate..................*argentata.*

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[1] For bibliography and synonymy of the various species, see Genera Insectorum, fasc. 82c.

Boops and *olivacea* are in Horn's section VIII, *trifasciata* and *suturalis* in his section X, *viridicollis, argentata, cubana* in his section XVIII though *cubana* was unknown to him, and *marginata* in his section XXVI. *Cardini* does not enter any of his sections.

Cicindela marginata *Fabricius.*

Brownish bronze or olivaceous. Head clothed with short decumbent hairs, sparse on the front and apex, dense on the sides below the eyes. Thorax feebly rounded at the sides, sparsely covered with short decumbent hairs. Elytra densely punctured; markings consisting of a basal dot, an uninterrupted marginal band, an oblique humeral lunule (hooked at the top), a somewhat confused tortuous middle band, an apical lunule inflected on both ends. Body beneath green-bronze, sides hairy. Legs green-bronze; hind trochanters red. Length, 11–12 mm.

Occurs in Florida, Bahamas and Cuba. In the United States it extends as far north as Maine, always on marshy sea coasts.

Cicindela cardini, n. sp.

Plate XII, Fig. 3.

Elongate, green, with a white vitta on each elytron, legs and mouth parts yellowish. Labrum yellow, narrower at apex than at base, as long as broad, feebly unidentate in front and with a few submarginal setæ. Mandibles yellowish, becoming piceous at the extremities. Tarsi yellow, setæ darker at extremities. Antennæ piceous except four basal joints which are yellowish. Head, except the labrum, brilliant shining metallic green, finely strigose between the eyes and on the occiput where the strigæ become wavy and transverse, almost glabrous, a few white setæ between the eyes and on the genæ; eyes very prominent, yellowish. Pronotum brilliant shining metallic bluish green, almost glabrous, bearing only about ten white hairs on each side; surface transversely strigose, the strigæ interrupted by a fine but deep median channel, which is connected with subapical and subbasal transverse furrows in which the blue reflection is more apparent; flanks of thorax pure green, densely punctulate, with six obsolete striæ and about as many white setæ. Elytra bluish green, not shining except feebly at margins, very finely densely punctulate without granules or foveæ, sides parallel, apex rounded with the sutural margin prolonged into a sharp little spine and the apical margin finely crenulate. A whitish vitta on each elytron involves the humerus and runs near and parallel to the external margin becoming confluent with an apical lunule; it is of nearly uniform width and is slightly but abruptly expanded at two-thirds its length. Beneath the color is metallic green, somewhat rufescent on ventral segments which are copiously clothed with decumbent white hairs at sides; the side pieces of the meta- and mesosternum are also hairy. The coxæ are prominent and clothed with decumbent hairs on one side but it is difficult to discover any hairs on the trochanters. The legs are dark yellowish, the tips of the femora, of the tibiæ and tarsi darker; the legs bear numerous erect white bristles. Length, ♂, 8.5 mm., ♀, 10 mm.

Described from two specimens ♂ ♀ (7356*a* and *b*) in the U. S. Nat. Museum, received from Patricio Cardin of the Agr. Sta. at Santiago de la Vegas, and labelled as having been collected by José Cabrera, at Contorro, Province of Havana, on August 18, 1910. This species, which is dedicated to Mr. Cardin at the suggestion of Mr. E. A. Schwarz, differs remarkably in its pattern of maculation from all other Antillean species.

Cicindela boops *Dejean.*

Plate XII, Fig. 4.

Subcylindrical, greenish and coppery, bronzed above; elytra punctate lateral margin (subinterrupted in front and dentate within) an abbreviated

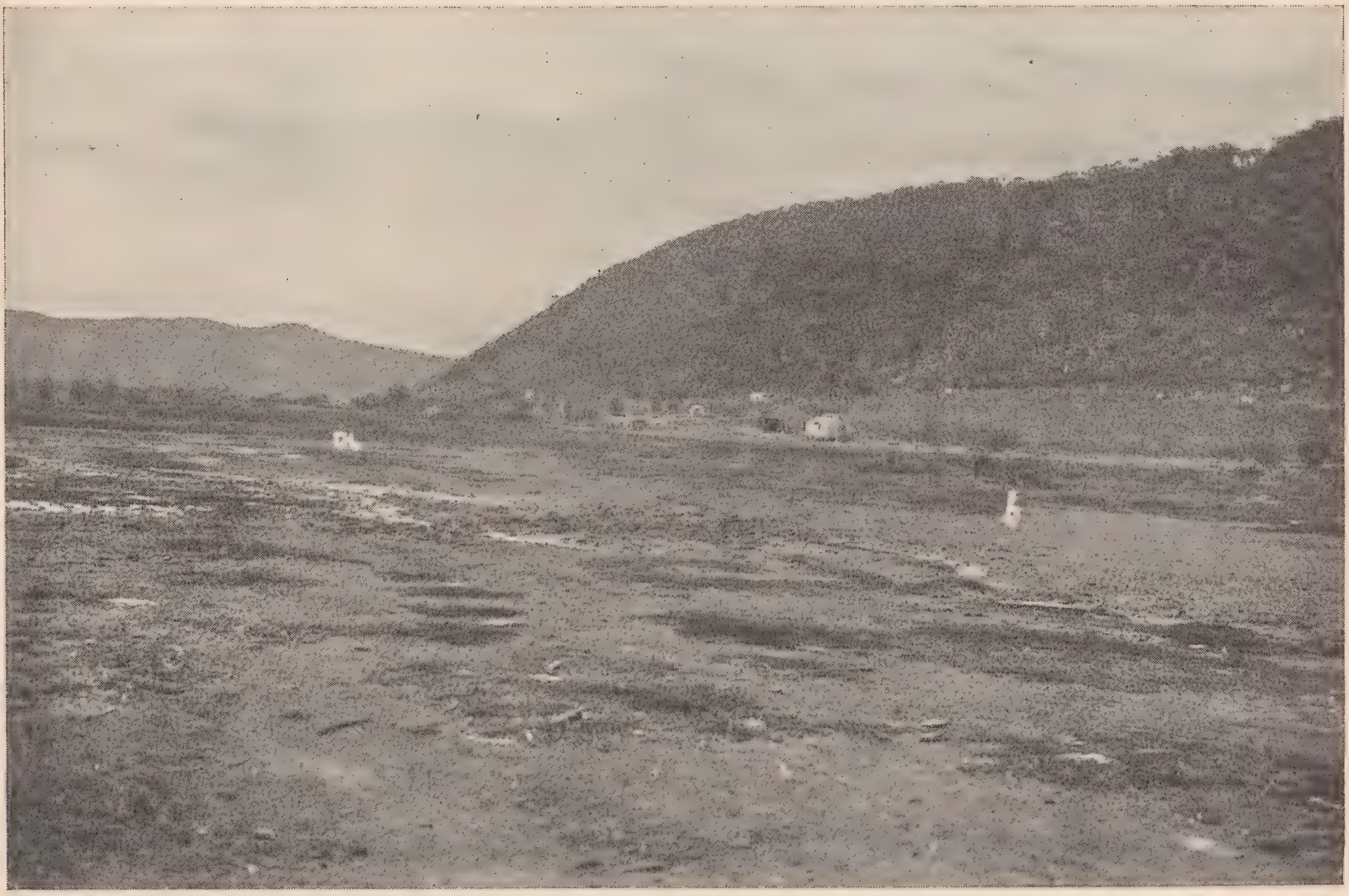

Fig. 2. Alkali flat at Santa Rita, Porto Rico.
(*a*) Low muddy section. *Cicindela boops* was found in this part.
(*b*) Higher and sandy portion. In this section *Tetracha sobrina* var. *infuscata* was found under dung and débris. *Cicindela trifasciata* was found alongside a small brook. Farther back the ground was somewhat higher, cacti grew in profusion and no *Cicindelæ* were found there.

and subtransverse fascia at middle and a lunule at apex, white; anus testaceous. In our series considerable variation in the extent of the white markings is shown, almost complete obliteration thereof being the extreme. Length, 10.5 to 14.0 mm.

Occurs in Cuba, Hispaniola and Porto Rico.

Represented by specimens collected at Santa Rita, Porto Rico, by Prof. Henry E. Crampton and A. J. Mutchler. Gundlach (Coleop. de Cuba, p. 11, 1891)[1] records it from Cardenas, Cuba.

Cicindela olivacea *Chaudoir.*

Elongate, convex, cribrately punctate, olivaceous above, white beneath; labrum and markings of elytra consisting of a simple humeral lunule, an apical lunule angulate in front, a middle band arcuate towards middle, and a marginal spot behind and beneath the band, all ivory white; middle of the body longitudinally smooth, coppery green; anus yellow. Length, 11.0 to 11.5 mm.

Occurs only in Cuba. Gundlach says he found this species on the coast near Havana. It has not been found in our expeditions.

Cicindela trifasciata *Fabricius.*

Dark greenish bronze; elytra with lateral white margin sinuate, with hooked apical and humeral lunule and a tortuous S-shaped middle band. Length, 12.0 mm.

Occurs in Florida, Bahamas, Cuba, Grand Cayman, Hispaniola, Porto Rico, St. Thomas, Jamaica, Barbuda, Antigua and Guadeloupe, so far as known and possibly in many of the smaller islands. On the Atlantic Coast it extends northward to North Carolina (Southern Pines, Manee) also along the Gulf Coast and southward to southern Mexico and in a very slightly modified form it reappears on the Pacific Coast.

It is represented by numerous examples in the Museum Collections and the Harris Collection.

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[1] This work appeared at intervals as supplements to the Anales Acad. Cien. Med. Fis. Nat. of Havana under the general title "Contribucion a Entomologia Cubana"; and was also published in book form in three volumes: I, 1881, Lepidoptera; II, 1886, Hymenoptera, Neuroptera, Orthoptera; III, 1891, Coleoptera. See Ramsden, Ent. News, XXVI, 1915, p. 259.

Cicindela suturalis *Fabricius.*

Plate XII, Fig. 5.

Head and thorax bronze green; sides and flanks of thorax sparsely covered with white pile; an elongate, triangular, sutural mark covering one-half of the basal portion of each elytron and extending, on both sides of the suture, to a little more than one-half way to the apex; the edges of the triangular mark are more or less irregular, and the apex is sometimes expanded so as to constitute a narrow, transverse fascia. In addition, some specimens show a more or less distinct arcuate dark line surrounding the transverse fascia, the lines of each elytron often joined at the suture between the fascia and the apex of the elytra. Body beneath green, sides with white pile. Length, 8.5 to 10 mm.

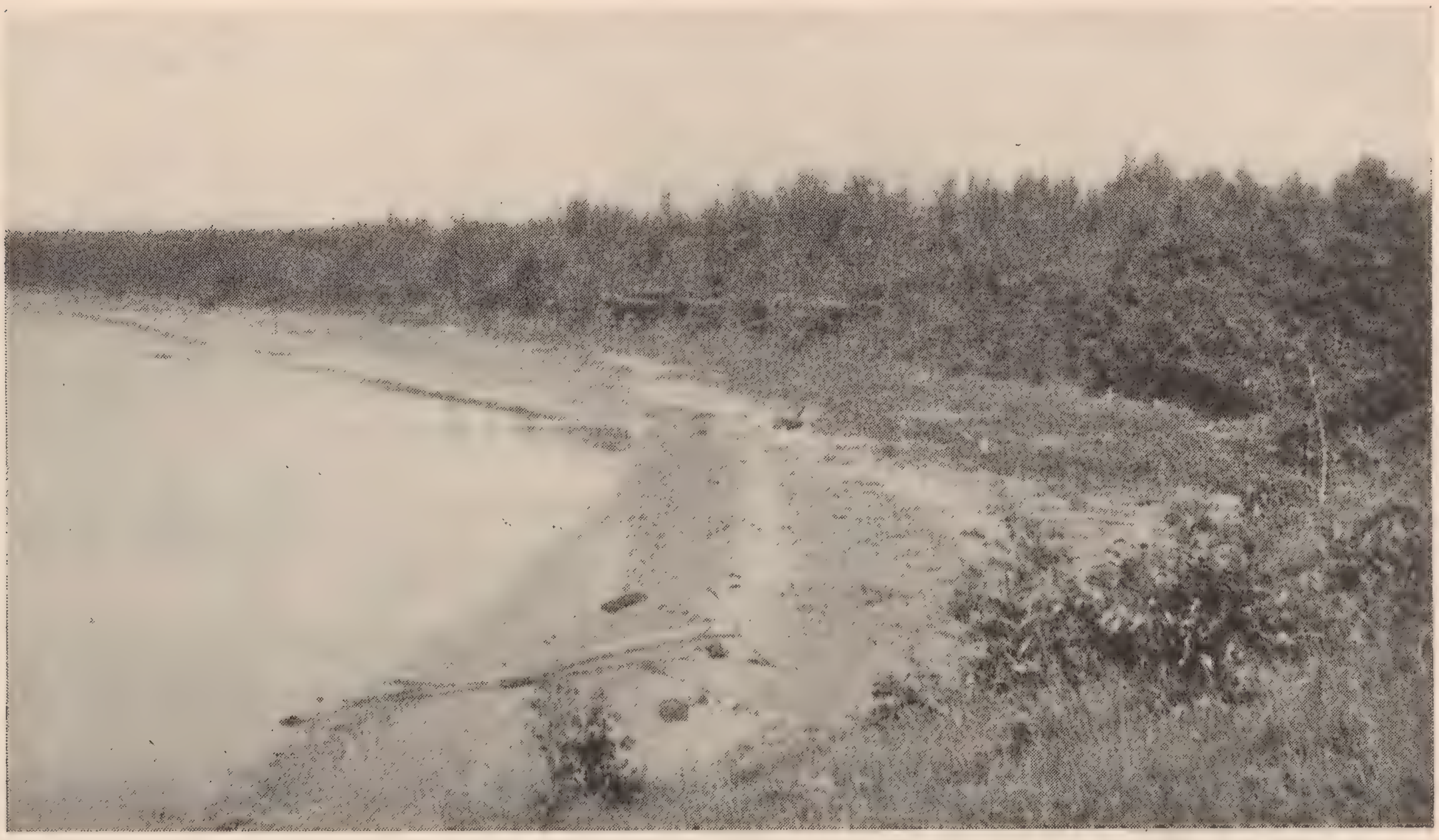


Fig. 3. Beach at Samana Bay, Santo Domingo, about three-eighths of a mile west of Sanchez. *Cicindela trifasciata* was collected at this place by Mr. F. E. Watson.

Occurs in Hispaniola, Porto Rico, St. Thomas, St. Bartholomew, Barbuda, Antigua, Guadeloupe, Martinique, Barbados, St. Vincent and Grenada, so far as known; also in Venezuela, Amazon region, Colombia in South America. Gundlach (Anales de la Soc. Esp. de Hist. Nat., II, p. 290, 1894) states that it does not occur in Cuba; we have no Cuban records and it does not reach the United States.

Collected by Dr. F. E. Lutz at St. John, Antigua, on June 15, 1911.

We have seen specimens also in Harris Collection from St. Thomas, from Calais Beach, Barbados, and from Brazil.

Cicindela suturalis var. **hebræa** *Klug.*

Plate XII, Fig. 6.

Head, thorax and underside same as in typical form. Elytra bronze green with an uninterrupted marginal band, dilated and nearly covering the entire apical portion where it is bidentate on the inner side; basal lunule hooked and a tortuous S-shaped middle band. Length, 7.25 to 8.5 mm.

Collected at Puerto Plata, St. Domingo, May 8, and July 6, 1915, by Mr. F. E. Watson and at Añasco, P. R., June 21, 1915, by Lutz and Mutchler. We have seen specimens also in the Harris Collection from Añasco, Porto Rico, Sept. 1, 1913, and from Colombia and Brazil.

Mr. J. Purves (Ann. Soc. Ent. Belg., XVII, p. 120) says that *hebræa* and *suturalis* occur on the sea beach all around Antigua and male *suturalis* was often seen in copulation with female *hebræa.* Our records from that island do not support this statement, for *suturalis* and *trifasciata* but not *hebræa* were found there by Dr. Lutz and *hebræa* and *trifasciata* (not *suturalis*) in Porto Rico by Lutz and Mutchler and again in St. Domingo by Mr. Watson. In all our collections *hebræa* and *suturalis* have never been found together. *C. trifasciata* has, however, been found in each locality running on the same beach, sometimes a little further back from the sea. In this connection the similarity in the genitalia, as shown by our illustrations (Plate XII, Figs. 9 and 10) indicates the possibility of such copulation between diverse species and indeed such has been noted by Davis (Ent. News, 1903, p. 270) and by Johnson (Journ. N. Y. Ent. Soc., II, 1894, p. 142).

Cicindela suturalis var. **guadeloupensis** *F. and S.*

Fleutiaux's notes on the Guadeloupe form, which we have not seen, are as follows: Variety almost black; punctuation of elytra more serrate than in the type; white markings narrow as in the specimens from Colombia, while in specimens from other parts of Antilles, from Brazil and Cayenne, they are wider and extend so as to invade almost the whole surface of the elytra (v. *suturalis* Fab.). What seems remarkable is that this variety, constant and confined to Guadeloupe, is always darker than the type and at the same time less brilliant; it is just the contrary with *trifasciata.*

We regard the supposition of the identity of *guadeloupensis,* described from Guadeloupe, with *nocturna,* described from South America, as questionable but our inability at present to inspect M. Fleutiaux's type prevents further investigation.

Cicindela viridicollis *Dejean.*

Plate XII, Fig. 7.

Subcylindrical, head and thorax green shining, elytra brown bronze with a humeral white dot and another behind the base, a recurved middle band and apical lunule subinterrupted, base of antennæ, femora and tibiæ pale testaceous, shining bronze. Length, 7 to 8 mm.

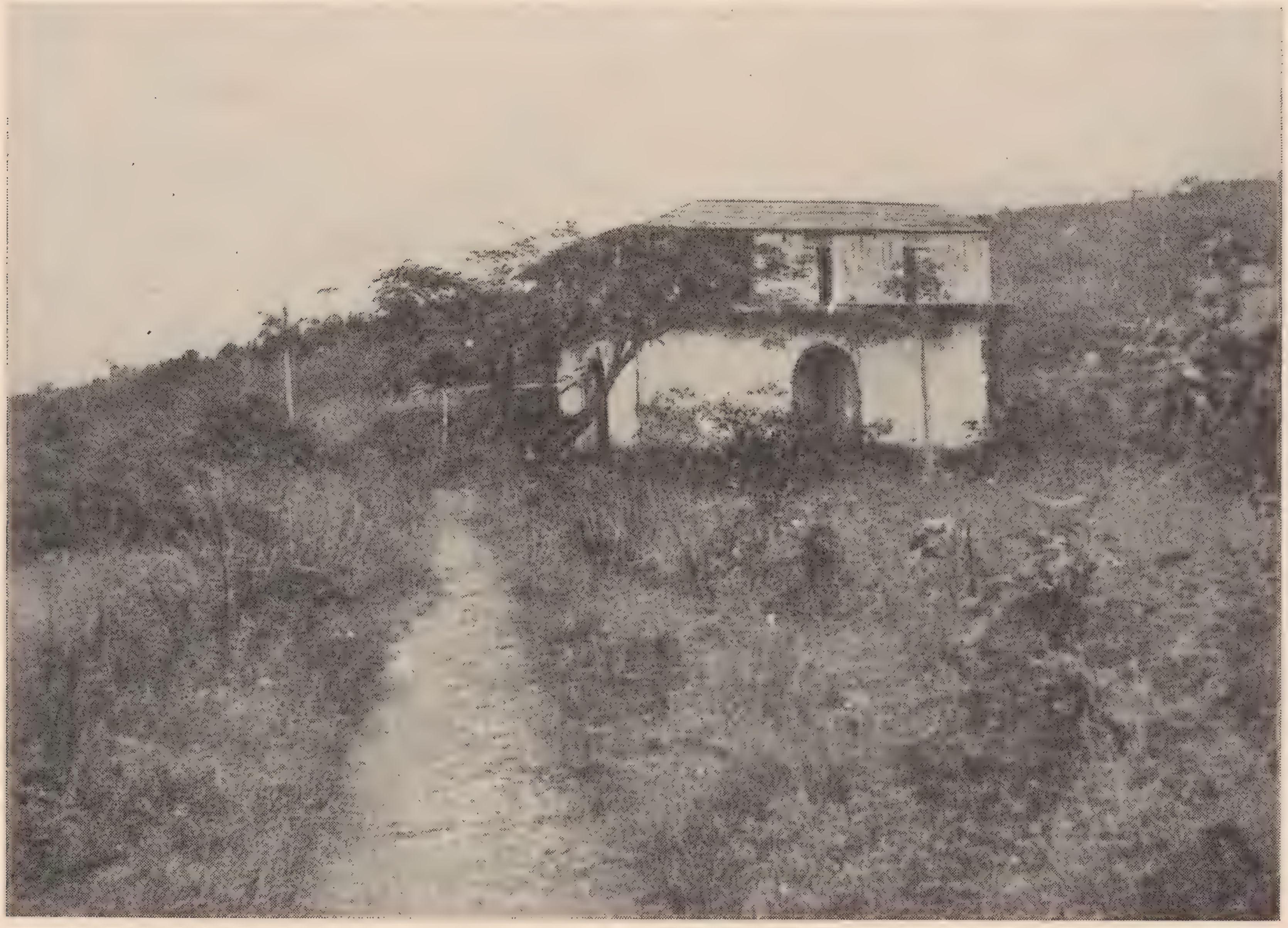


Fig. 4. Locality at Baños San Vincente, Cuba, where *Cicindela viridicollis* was found along the path.

Occurs only in Cuba. Our expedition to Cuba in September, 1913, found this species at two localities in Piñar del Rio province, Baños San Vincente and Cerro de Cabras, running along paths through grassy fields. It flies weakly and, while flying, the brilliant green head and thorax are so conspicuous as to suggest a small bee rather than a *Cicindela.* There are also specimens in Harris Collection taken by Prof. H. F. Wickham near

Havana; and in the Museum collection taken by Mr. Barnum Brown in Santa Clara province.

Cicindela argentata var. **pallipes** *F. and S.*

The name given to the Guadeloupe insect is treated as a synonym by Dr. Walther Horn. It is known to us only by Fleutiaux's figure and description which may be translated as follows: This variety is distinguished by the dark color of the head and thorax, by the apex of elytra less shortly rounded and by the yellow legs and first antennal joint.

At 500 ft. elevation in fields of red soil.

Occurs only in Guadeloupe. The species as a whole extends from Argentine to Sonora.

Cicindela cubana, n. sp.

Plate XII, Fig. 8.

Similar in size and form to *C. viridicollis*. Coppery bronze in color with a subsutural row of large bluish green foveæ and smaller foveolæ scattered over the elytra; dark blue and coppery patches intermingled on the head. The white markings on the elytra consist of a marginal stripe strongly dilated at the middle, more feebly behind the humerus, and narrowly separated (not separated in one male) from the apical lunule, and also of two small discal dots, one at about one-fourth from base, the other at about three-fourths from base, or where the terminus of the middle band would be if complete. The middle band is represented in the dilation of the marginal stripe at middle and by its very short and narrow prolongation towards the posterior discal dot. The color beneath is bluish metallic, except the thorax, which is coppery, and the legs, mouth parts and anus, which are testaceous; the legs faintly metallic; the last joint of the palpi dark. The labrum is very long, white, strongly arcuately narrowed to apex, where it is feebly bisinuately emarginate, with a small acute tooth at middle of the emargination; it is glabrous but bears a few submarginal setæ. The head is glabrous, except for five or six decumbent setæ on the genæ and two erect setæ beside each eye; it is deeply strigose between the eyes; the scape of the antennæ bears a single seta, and the succeeding joints also a few. The pronotum is coarsely punctured with a feeble transverse arrangement of the sculpturing; decumbent white setæ are copious at sides but lacking broadly at middle, where there is a well defined narrow median channel connected with anteapical and antebasal transverse channels. The elytra are densely punctulate, serrulate at margin in apical fourth and the apex of each is prolonged into a short spine. The pubescence beneath is white and fairly dense on sides of abdomen and flanks of body and thorax. The legs also have erect distant setæ. Length, ♂, 6 mm.; ♀, 7.5 mm.

Four specimens were found by Dr. Frank E. Lutz and his companions on sandy paths through the sparse low pines 12.5 kilometres south of Piñar del Rio, Cuba, in September, 1913. The character of the region is shown by accompanying photograph.

This species resembles most *C. viridicollis* and has the setal characters of that species but differs in the labrum, which in *viridicollis* is shorter, truncate and not dentate at apex; in the sculpture of the pronotum, which in *viridicollis* is distinctly transversely strigose; as well as in the color and markings, which in *viridicollis* include a conspicuously metallic green head and thorax and a complete middle band.

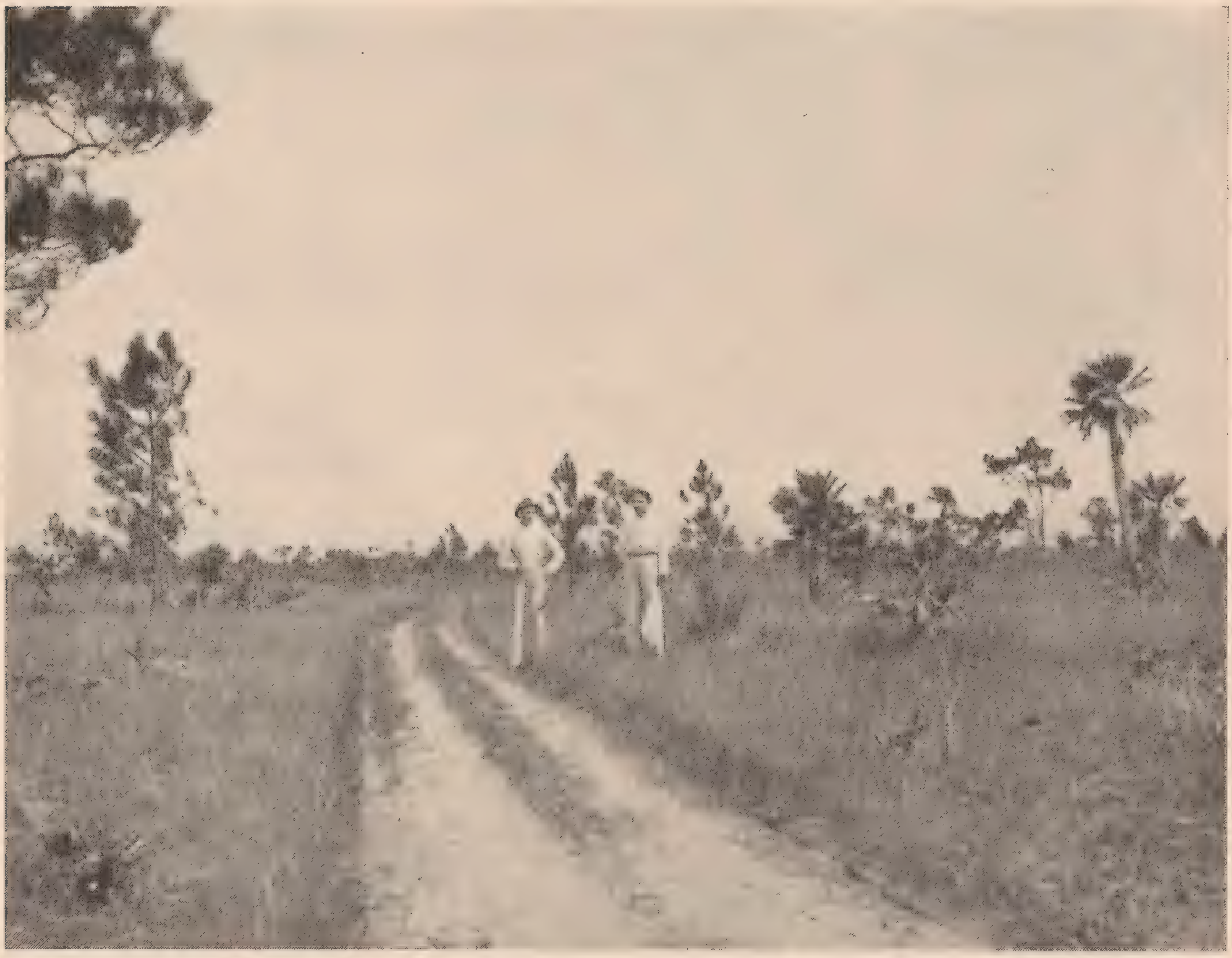


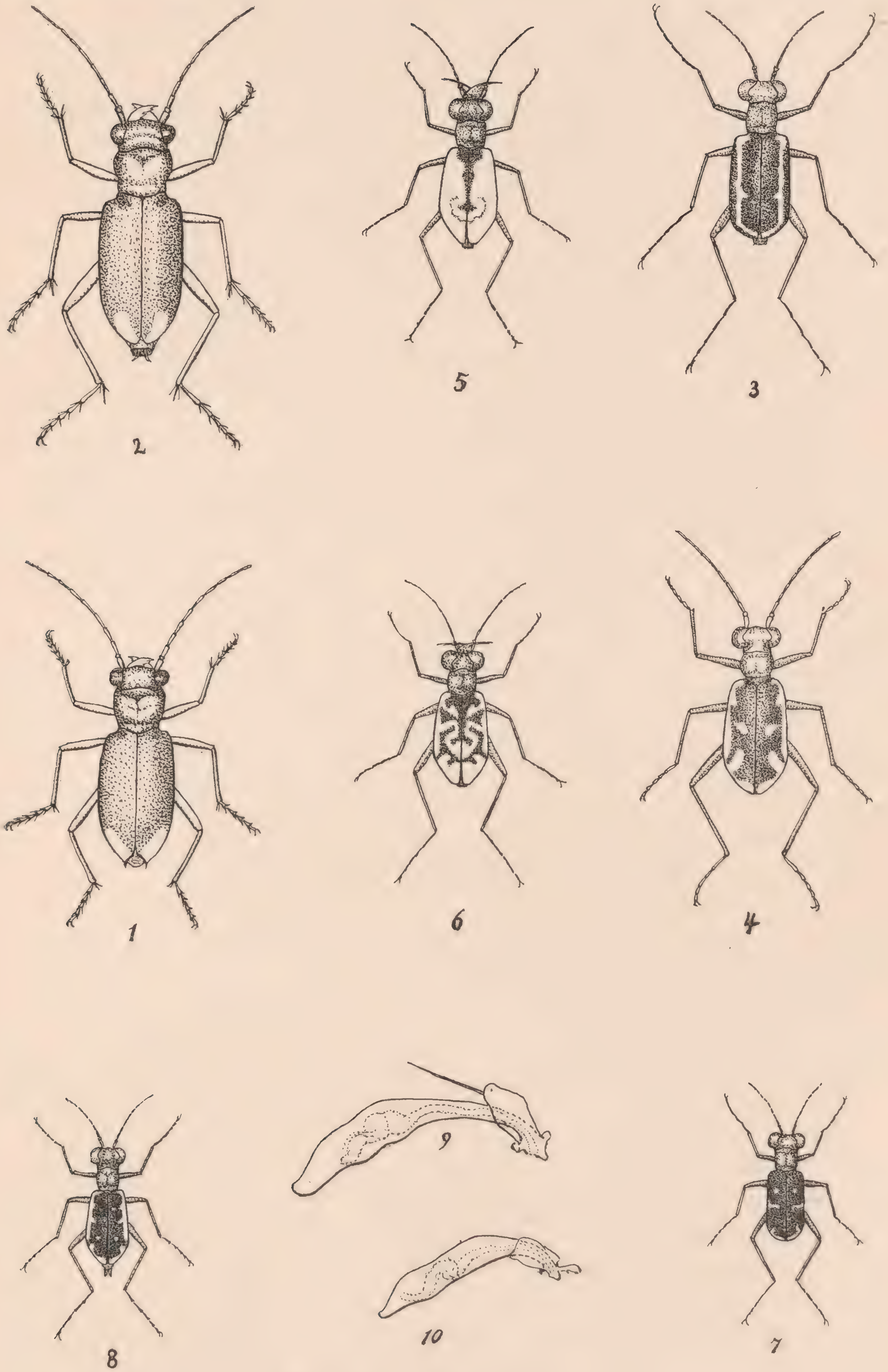
Fig. 5. Locality 12½ kilometres south of Piñar del Rio, Cuba, on the road to Coloma, where *Cicindela cubana* was found by Dr. Lutz.

In addition to the species enumerated above there are in the Museum collection eight specimens of *Cicindela dorsalis* var. *venusta* bearing the label "Santiago de Cuba." These specimens were purchased from a dealer, from whom no further information can be obtained. There is good reason to expect this species to occur in Cuba, but in view of Gundlach having failed to find it there, and the possibility of error in the labelling of our specimens, we do not at present include the species in the West Indian list.

EXPLANATION OF PLATE XII.

Fig. 1. Tetracha acutipennis Dejean.
" 2. " sobrina var. infuscata Mann.
" 3. Cicindela cardini, n. sp.
" 4. " boops Dejean.
" 5. " suturalis Fabricius.
" 6. " suturalis var. hebræa Klug.
" 7. " viridicollis Dejean.
" 8. " cubana, n. sp.
" 9. Male genital tube of C. trifasciata.
" 10. " " " " C. suturalis var. hebræa.

Figures 1–8 are enlarged two diameters; Figs. 9 and 10, about nine diameters.



WEST INDIAN CICINDELINÆ.

56.81.9P

Article XXXVII.— A NEW CRESTED TRACHODONT DINOSAUR *PROSAUROLOPHUS MAXIMUS.*

By Barnum Brown.

Among the fossils secured by the American Museum Expedition of 1915 are several Trachodont skulls from the Belly River exposures of the Red Deer River, Alberta, one of them of huge size and generically distinct from any heretofore described.

It belongs to the subfamily Saurolophinæ and from the development of the facial bones and the form of the incipient crest appears to be directly ancestral to *Saurolophus* of the Edmonton formation.

This animal was one of the largest of the Trachodonts and the skull offers another example of the great variety of facial development among the Crested Trachodonts.

When found the right side of the skull was weathered off almost to the mid-line and the parietal section was crushed upward laterally so that both supratemporal arches appear from a side view. The premaxillaries were separated from the skull and they have been replaced in their proper position. All sutures are clearly defined excepting the union of the nasals and frontals underlying the crest.

Prosaurolophus maximus gen. et sp. nov.

Type of genus and species, an incomplete skull and jaw, No. 5386.

Horizon and locality. Belly River formation 100 feet below top of beds, north fork of Sand Creek, 12 miles below Steveville, Red Deer River, Alberta, Canada.

Generic and specific characters. Skull large, high, and elongate. Incipient crest short, erect, directly above the eye, and formed by prefrontals, frontals and nasals. Frontals excluded from the border of the orbit. Beak long and spatulate. Lachrymals long and narrow. Nasals high posteriorly.

The skull is considerably larger than the type specimen of *Saurolophus osborni* and the general form and relationship of the elements compares closely with that of *Saurolophus,* excepting the crest which is composed of the same elements but is small, erect, and not prolonged backward. In fact a description of other elements composing the skull that are visible in *Saurolophus* would serve equally well for those of *Prosaurolophus* and I am convinced that this form is ancestral to *Saurolophus.*

From a comparison of the material now prepared in the American Mu-

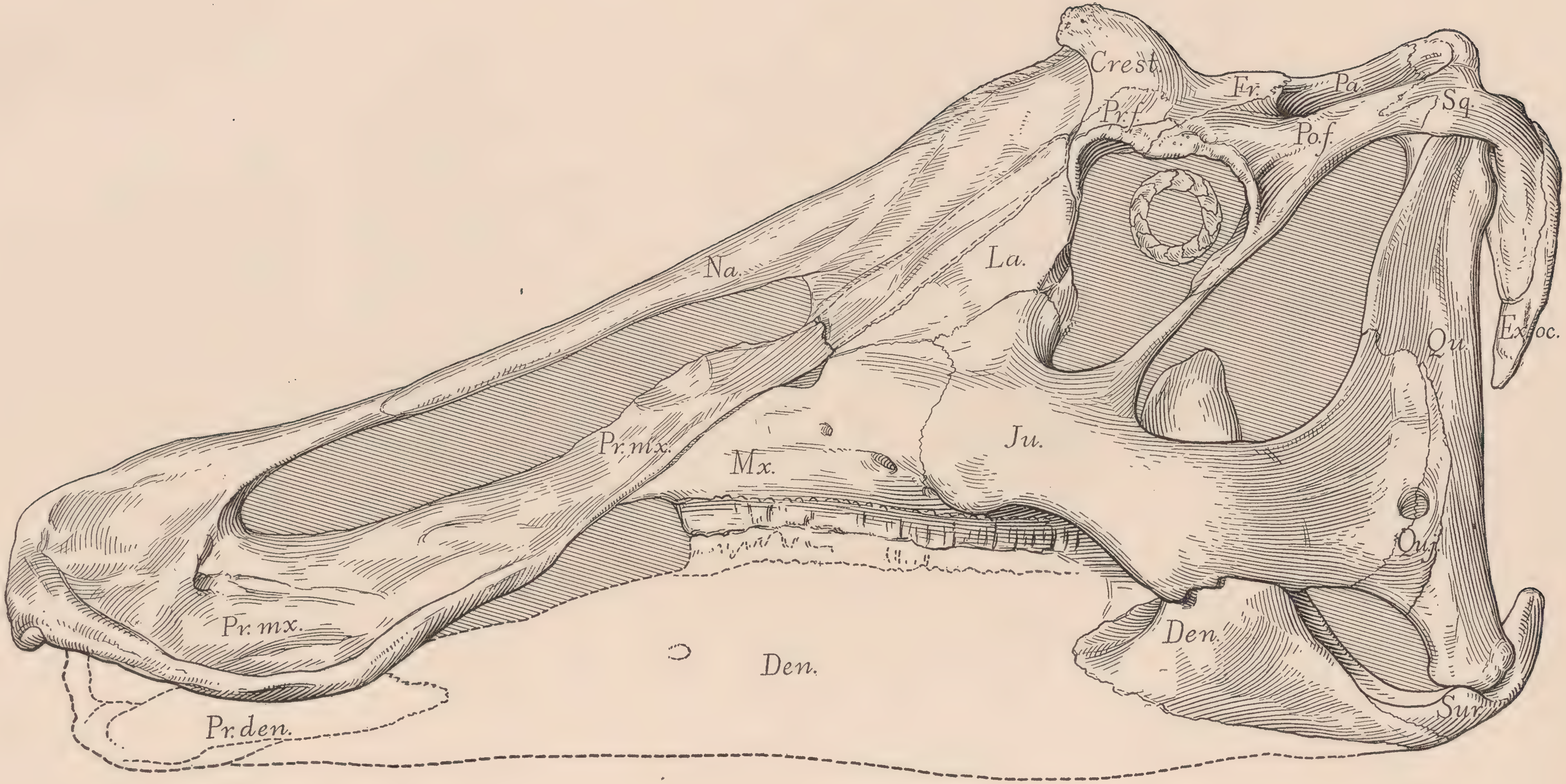


Fig. 1. Side view of *Prosaurolophus maximus* skull, reconstructed by elimination of crushing. $\frac{1}{7}$ natural size.

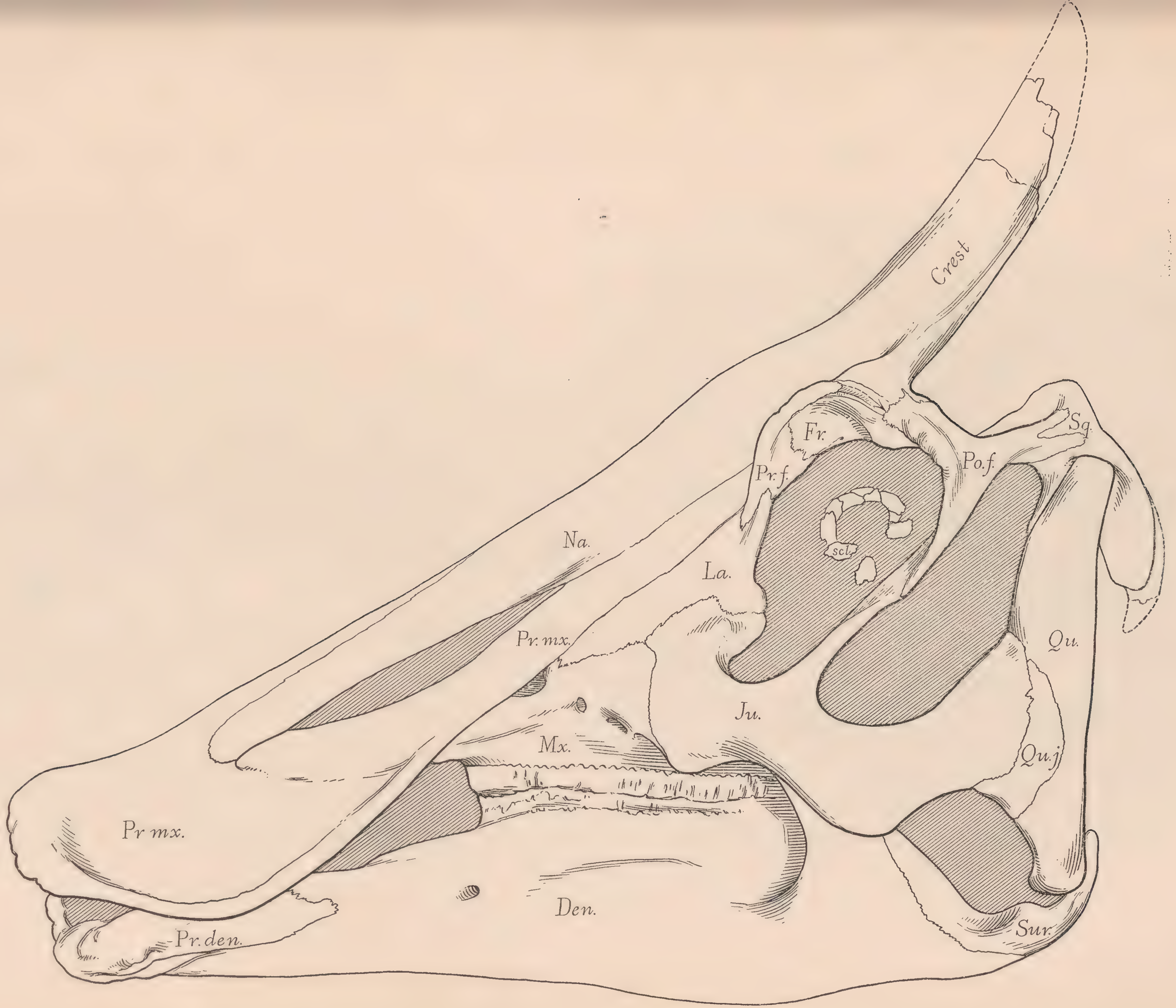


Fig. 2. Side view of *Saurolophus osborni* skull, original drawing reversed for comparison. $\frac{1}{7}$ natural size.

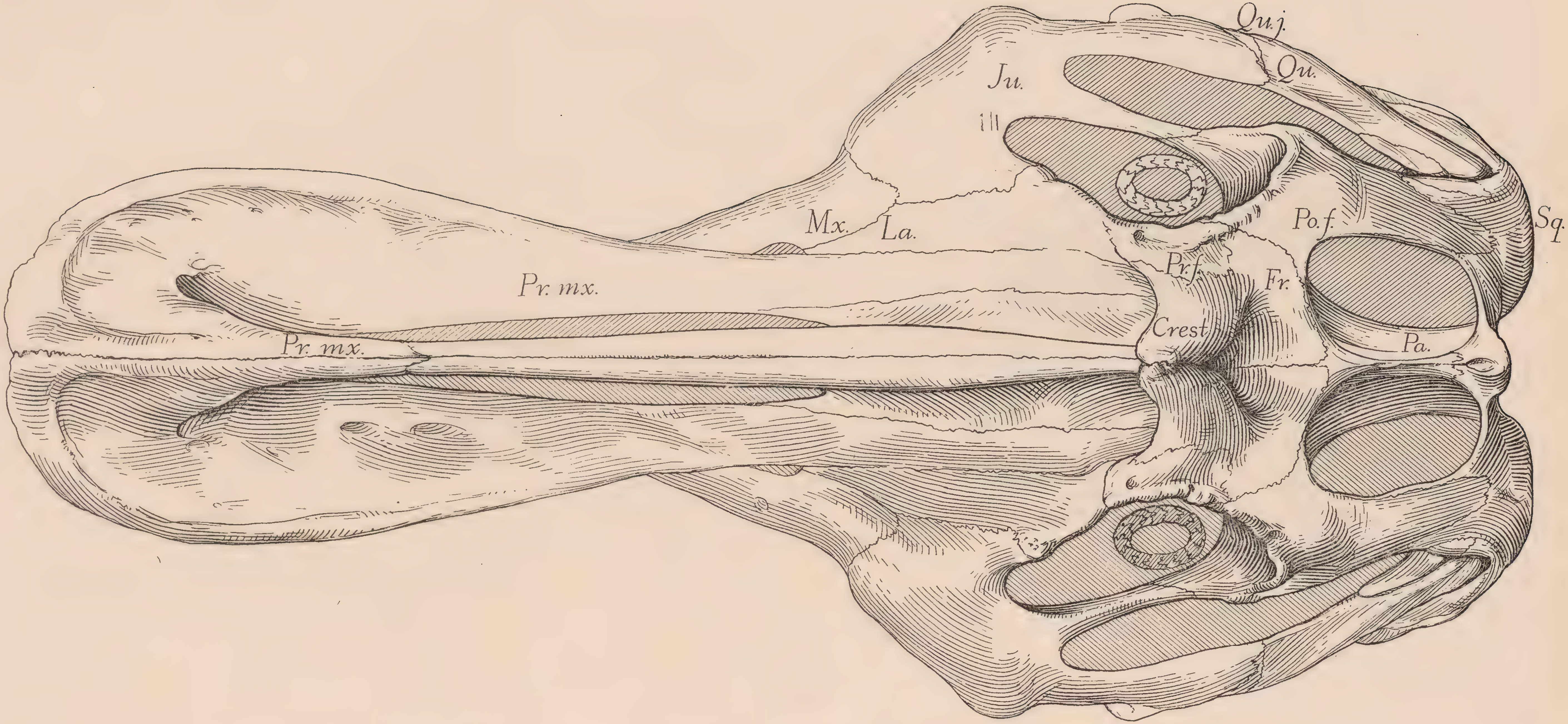


Fig. 3. Dorsal view of *Prosaurolophus maximus* skull, reconstructed. $\frac{1}{7}$ natural size.

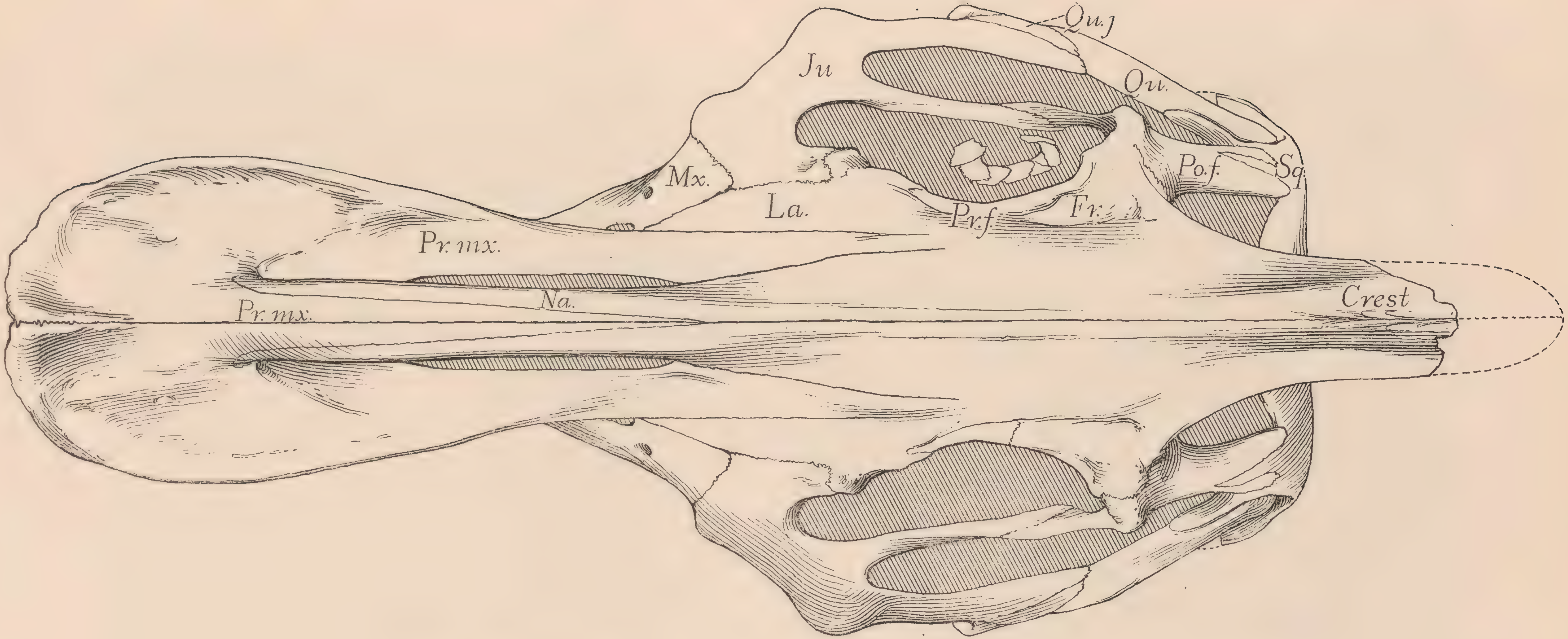


Fig. 4. Dorsal view of *Saurolophus osborni* skull, reconstructed. $\frac{1}{7}$ natural size.

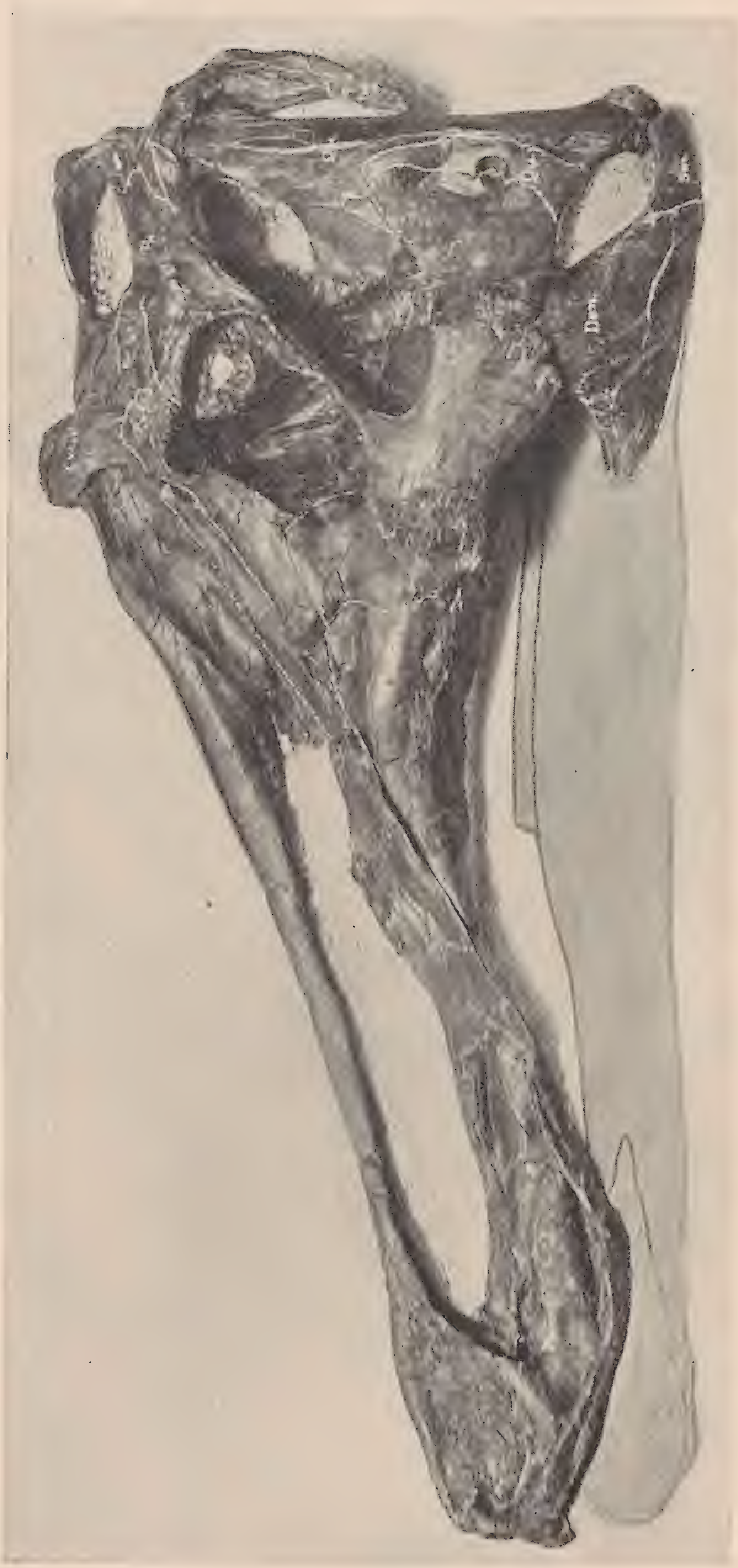


Fig. 5. *Prosaurolophus maximus* skull, type, missing part of jaw painted on base.

seum it seems evident that there were at least two distinct forms of crest among the Trachodonts: straight spike crests and helmet crests. The spike-like crests are correlated with long heads, spatulate-shaped beaks and a maximum number of teeth equal to *Trachodon.* The helmet-crested forms were short-headed and short-beaked with reduced number of teeth.

As yet I am unable to correlate these distinct forms of crest with distinguishing characters in the skeleton and group them together in the subfamily Saurolophinæ as defined in a previous paper.[1]

The crest is comparatively low, short anteroposteriorly and slightly curved forward at the apex with roughened superior border. It is apparently derived primarily and chiefly from the anterior lateral border of the frontals, supported at the base by the prefrontals and in front formed by the posterior prolongation of the nasals. By extending this crest upward and backward the exact condition of the crest in *Saurolophus* would be fulfilled.

The nasals are high posteriorly, rising to form the front of the crest, with sides slightly concave and their superior border in front of the crest roughened as in *Saurolophus.* The anterior ends of the nasals extend a little beyond the middle of the external nares and are separated by the superior processes of the premaxillaries. The anterior ends of the nasals in *Saurolophus* are heavier and extend to the anterior end of the external nares.

The beak is long and spatulate as in *Saurolophus* and readily distinguished from the abrupt broad beak of *Trachodon* and the shorter, narrow triangular beak of *Corythosaurus* and closer allied genera. Its lower and anterior border is roughened by large pseudo-denticles and the inferior process of the premaxillary extends to the prefrontal, overlapping the long lachrymal as in *Saurolophus.*

The maxillary, lachrymal, jugal, quadratojugal, quadrate, postfrontal, squamosal, frontal and parietal are in form and relation exactly comparable to those of *Saurolophus.*

Near the center of the quadratojugal there is a round depression which does not penetrate the bone and which apparently has no morphological significance for it is not present in any other known Trachodont skull.

As in all crested Trachodonts the parietal is free from the crest.

The maxilla has been crushed vertically and reduced in height; it was large as in *Saurolophus.* A part of the maxillary alveoli are preserved showing more than 45 rows of teeth but the exact number of rows cannot be determined.

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[1] Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, Art. xxxiv, pp. 559-565, 1914.

The posterior end of the lower jaw that is preserved shows a deep dentary, high coronoid process and a long posterior inwardly directed hook on the surangular. From the form of the beak it is evident that the edentulous anterior end of the dentary was long and not abruptly decurved as in *Kritosaurus* or the shorter beaked helmet-crested Trachodonts.

In this specimen the orbital ring of sclerotic plates is complete although badly broken. The plates resemble those of *Saurolophus*. Sclerotic plates have been found in *Trachodon*, *Saurolophus* and *Prosaurolophus*, and they were probably present in the eyes of all Trachodonts.

Measurements.

	mm.
Extreme length of skull, paroccipital process to end of beak	1300
Length distal end of quadrate to end of beak	1200
Height of quadrate	420
" " crest above border of orbit	160

56.81,9C:14.71

Article XXXVIII.—*CORYTHOSAURUS CASUARIUS:* SKELETON, MUSCULATURE AND EPIDERMIS.

Second Paper.

By Barnum Brown.

Plates XIII–XXII.

This genus and species was founded on a skeleton of a new crested dinosaur in 1914, and a detailed description of the skull was given at that time (Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, Art. XXXV, pp. 559–565, Oct. 8, 1914).

The skeleton, No. 5240, is now prepared and mounted and a more extended knowledge of the anatomy can be presented but detailed description and figures of individual bones must be derived later from another specimen.

The missing parts of the front limbs in the type specimen found in 1912 have been restored from a second nearly complete skeleton of the same size and species, No. 5338, found in 1914, a few miles below Steveville.

The impression of the epidermis covering the greater part of the body has been skillfully worked out in detail by Mr. Otto Falkenbach and although faint in places, where covered by masses of vegetable material, the general pattern is fairly well determined, likewise the outline of neck, body and tail.

It is evident from attendant circumstances of deposition that the carcass had drifted on a beach. The bedding plane under the body was unusually irregular; a complete skeleton of a young Baënid turtle, No. 5241, and several water-worn Trachodont bones were lying under the tail; *Unio* shells were abundant all round, and over the body three distinct masses of sandstone were deposited in folds, the cross-bedded planes showing water currents from different directions.

It was lying on the left side and the skin impression on the left side is continuous but the mass of vegetal material on which it was lying did not allow a clean-cut definition of the pattern. Better defined areas appear in sections on the right or upper side where the silts were homogeneous but patches of the skin were torn off in places, consequently it was deemed advisable to preserve the skin on both sides wherever possible and expose only those bones not covered.

All blocks are united as found, and the specimen is erected from the horizontal to a vertical position, assuming a pose it may well have taken in swimming.

The second skeleton, No. 5338, establishes the proportion of the front limb in this genus, in which the radius is much longer than the humerus. It also determines the type of *Trachodon marginatus*, a front leg described by Lambe, to have been correctly referred at first to the genus *Trachodon*. This species was later taken as the genotype of *Stephanosaurus*.

Corythosaurus casuarius may now be defined as follows:

Corythosaurus casuarius.

Generic and specific characters. Skull comparatively short with a high helmet-like crest formed by nasals, prefrontals and frontals. Nasals not separated in front by premaxillaries. Beak narrow, expanded part in front of nares elongate. Narial opening small. Vertebral formula C. 15, D.19, S. 8, Cls. 61+. Dorsal spines of medium height. Anterior caudal spines high. Chevrons long. Scapula long, blade of medium width. Radius considerably longer than humerus. Metacarpals comparatively short. Ilium decurved anteriorly. Ischium long with foot-like terminal expansion. Pubis with anterior blade short and broadly expanded at end. Femur longer than tibia. Phalanges of pes short. Integument over sides and tail composed of polygonal tuberculate scales without pattern but graded in size in different parts of the body; belly with longitudinal rows of large conical limpet-like scales separated by uniformly large polygonal tubercles.

This definition compared with that of *Hypacrosaurus* (Bull. Amer. Mus. Nat. Hist., Vol. XXXII, Art. XX, p. 396, 1913) shows a general similarity of structure. The two genera are closely related, and *Corythosaurus* may have been the ancestor of *Hypacrosaurus*. They are distinguished at present by the development of the vertebræ and differences of proportion in the fore and the hind limbs. *Hypacrosaurus* is typically an Edmonton genus. It has also been reported from the Two Medicine Formation of Montana, strata that are determined as of Judith River (Belly River) age (Gilmore, Smithsonian Miscellaneous Collections, Vol. LXIII, No. 3, Publication 2262, p. 10, 1914), but which I believe may be of Edmonton age.

Skeleton.

The skull of *Corythosaurus casuarius* has already been described (loc. cit.).

The vertebral column is composed of 103 consecutive vertebræ and several are missing from the end of the tail, possibly twenty. It is divided as follows: cervicals 15, dorsals 19, sacrals 8, caudals 61+. In front of the caudals the matrix and integument obscure the centra so that it is impossible to give a detailed description of the vertebræ in this part of the body. The presacral vertebræ are apparently developed as in *Trachodon* and *Saurolophus,* with normal centra and spines, whereas in *Hypacrosaurus* the centra of the dorsals are reduced and the spines are extremely high and massive.

The ribs appear to be more slender than those of *Trachodon* or *Saurolophus.* Each presacral vertebra carries a rib, those on the last dorsals very small and delicate. The longest is the seventh dorsal and they decrease in length anteriorly and posteriorly from this point.

The spines of the anterior caudals are high and broad antero-posteriorly while the chevrons are extremely long, the first chevron being between the fifth and sixth caudals. Fifteen of the anterior caudals bear transverse processes.

The greater part of the fore-limb has been painted in from No. 5338, which has been worked out on one side only so that a detailed description must be deferred till this specimen is available. As a whole the fore-limb agrees with that of *Hypacrosaurus* in the greatly lengthened forearm as compared with *Trachodon.* The blade of the scapula is not so broad and is curved more than in *Hypacrosaurus,* and the radius is three inches longer than the humerus, whereas in *Hypacrosaurus* the radius is almost five inches longer than the humerus.

The pelvis resembles that of *Hypacrosaurus* with less deep but strongly decurved ilium; short pubis with broadly expanded blade and long postpubis; ischium elongate and massive, terminating in an expanded footlike end less massive than in *Hypacrosaurus.* The femur is considerably longer than the tibia and fibula, with the fourth trochanter low-down below the middle of the shaft. Pes with Mt. III not so markedly enlarged as in *Hypacrosaurus.* Phalanges short.

Tendons and Musculature.

The tendon bones in this specimen are unique, giving for the first time definite knowledge of their placement and furnishing a partial key to the musculature of unarmored predentate dinosaurs.

Tendon bones are present in the dorsal, sacral and caudal regions and do not extend below the transverse processes of the vertebræ. None are present in the cervical region.

Each tendon at its origin is flattened with fimbricated terminal points, the central rod is oval and at place of insertion tapers to a rounded point.

They are developed chiefly overlying the posterior dorsals, sacrals and anterior caudals, diminishing posteriorly and do not appear to have been present toward the distal end of the tail. They are disposed in two layers (Figs. 6–9), an outer and an inner series. In each series they are parallel one to another and both series are diagonal to the axis of the vertebral column.

Outer series. This series is best preserved and those tendons lying back of the sacrum can be traced accurately on both sides of the skeleton. Each tendon originates at the base of a spine, passes backward and upward across eleven spines and is attached to the anterior face of the twelfth spine at a point about two inches from the top.

Inner series. In this underlying series each tendon originates on the posterior outer face of the spine at a point two inches from the top, passes backward and downward apparently across seven spines and was attached at the base of the eighth. This series is not so well preserved as the outer one but is clearly demonstrated on the left side.

The tendon bones are clearly the calcified terminal parts of large deep-seated muscles that moved the vertebral segments in series. The contracted part of such muscles is well defined by these calcified sections but their origin was doubtless fleshy masses that extended in most cases beyond the part that has been preserved.

Another series of muscles is seen on the right side of the specimen (Fig. 10), where they are represented by raised parallel equidistant folds as large as the tendon bones but not calcified. They apparently originated on the ischium, cross the chevrons diagonally and are attached to the sides of the centra. This set is doubtless the *ischio-caudals.*

A fourth set of muscles, crossing the *ischio-caudals* at right angles (Fig. 10) is indicated just above the end of the ischium. These are fairly prominent at the border of the skin but rapidly become indistinct anteriorly. They are in the region of the cloaca and may represent the sphincter muscles.

In Trachodonts the footed ischia of the Saurolophinæ are developed much stronger than the rod-like ischia of the Trachodontinæ, comparatively greater than in the alligator, a comparison which leads to the conclusion that the tail was a more powerful organ in this subfamily, and I believe the crested Trachodonts were to a greater extent natatorial in habits.

In equally large carnivorous dinosaurs that habitually walked on the hind feet the tail is equally large but of different function, a balancing organ. In such forms the ischia are the least developed part of the pelvic bones.

In *Trachodon* the caudal tendons are arranged in two series similar to those of *Corythosaurus,* and the dorsal musculature was probably similar in both genera, but it cannot be determined from the present specimen. In a *Trachodon* skeleton, No. 5058, the tendons of the dorsal region are shorter and more complex than those of the caudal section. Anterior to the middle of the sacrum there are three series of tendons; 1st an outer series, a continuation of those along the tail; 2nd an inner series, probably a continuation of the inner series along the tail; 3rd a deep-seated series lying next to the vertebræ and parallel to the outer series. In each of these dorsal series the broad fimbriated end of the tendon is uppermost.

Epidermis.

Where a considerable part of a connected skeleton of any member of the Trachodontidæ is found it is exceptional not to find all or a part of the skin impression surrounding the bones, a fact that shows that the carcasses were rapidly covered before they were decayed. Usually there is direct associated evidence of water, shells, etc., that indicates an aquatic habitat for this family.

In all members of the family the skin is tuberculate and the tubercles or scales are never imbricated or overlapping as in lizards. No bony dermal plates are present.

In each genus the pattern of the skin is as characteristic as among modern reptiles, especially in the abdominal and pelvic regions, but species characters are not so clear. In two species of the genus *Trachodon, T. annectens* and *T. mirabilis*, the epidermis is alike so far as known.

In *Corythosaurus casuarius* the tubercles are rather uniformly large without differentiated pattern over the sides, back and tail. The abdomen, in the pelvic region, is characterized by rows of large raised oval limpet-like tubercles.

The preserved outline of the body in the type specimen shows that the neck was rather slender, somewhat deeper than wide; the body was narrow and deep; and the tail was extremely thin and deep back to the fifteenth caudal where the transverse processes disappear. Beyond this point the tail was a compressed oval in cross-section with the greatest diameter vertical and a slightly greater bulk is indicated on the lower side.

A median fold of skin extended along the back in the dorsal, sacral and caudal regions and presumably above the neck and skull. Over the anterior caudals and sacrals this fold rises five inches above the spines but in no place is it complete.

In the dorsal region rather sharp ridges or folds extended over the body at right angles to the vertebral column, shown in this specimen on the right side (Fig. 11), where the reverse impression of the left side is preserved.

This folded character of the skin is shown also in the mummy specimen of *Trachodon annectens*, American Museum Coll. No. 5060. In this specimen there are irregular ridges or folds extending from the vertebræ down across the body, especially in the shoulder region. These ridges appear to have been present in life as loose folds of skin similar to that of living iguanas.

Over the spines of the dorsals, sacrals and anterior caudals there are distinct vertical furrows which correspond to but are not in accord with the vertebral segments.

The epidermal markings over the entire body may be classified as of two kinds — polygonal tubercles and large conical tubercles.

Over the sides, back and tail the tubercles are rather uniformly large, although not so large as in *Trachodon*, polygonal in form and not differentiated in pattern. On the anterior dorsal region and on the inner side of the thigh overlying the fourth trochanter of the femur (Fig. 12) they are smaller than elsewhere. On the fleshy portion of the tail, back of the caudals that bear transverse processes, and on the median dorsal fold above the vertebræ the tubercles are uniform and slightly larger than those on other parts of the body.

The abdominal skin (Fig. 13) underlying the pelvis is characteristic of this genus. In this area the epidermis is marked by longitudinal rows of large raised limpet-like cones, four and one half centimeters in length and three centimeters in width. They extend in rows parallel to each other and the large conical tubercles are separated by uniformly large polygonal tubercles, in size and form similar to those covering the tail.

On the bottom of the hind feet (Fig. 14) there were distinct fleshy pads, apparently segmented as lobes under the metatarsals and at least the proximal phalanges. The palmar surface of these pads was covered by large low tubercles, in arrangement and form like those on the tail but apparently not raised above the surface of the epidermis.

Measurements of Corythosaurus casuarius.

	cm.
Length of vertebral column and skull, measured over top of spines from the mouth to the 61st caudal	935.
Height of centrum and spine of first caudal	47.5
Length of longest chevron (6th) from anterior end	38.5
Scapula, greatest length	89.
" " width	20.
Ilium, length	103.5
" height, anterior peduncle	20.5
Pubis, length of pubis and postpubis	100.
" greatest depth of anterior blade	27.

	cm.
Pubis, length of anterior blade from acetabulum to anterior end	49.
" narrowest depth of blade in front of peduncle	10.
Ischium, greatest length	103.
" length of terminal foot	22.
" least vertical diameter, middle of shaft	6.
Femur, greatest length	108.
" length of condyle anteroposteriorly	26.
" least diameter of shaft below distal end of 4th trochanter	13.
" position of 4th trochanter from central point to the top of femur	58.
Tibia, length of tibia and astragalus	100.
Fibula, length	95.
Pes Mt. II, length	31.
Mt. III, "	38.
Mt. IV, "	32.
Digit II, first phalanx	14.
" " second "	4.5
" " third "	8.5
Digit III, first phalanx	13.5
" " second "	4.
" " third "	2.5
" " fourth "	9.
Digit IV, first phalanx	11.
" " second "	2.5
" " third "	2.
" " fourth "	1.7
" " fifth "	9.5

EXPLANATIONS OF PLATES XIII–XXII.

Plate XIII.

Fig. 1. Combined three-section photograph of *Corythosaurus casuarius* type, left side, about $\frac{1}{30}$ natural size. Skeleton mounted as found partly covered by skin impression. Missing parts of front limb and lower part of abdomen painted in.

Fig. 2. Outline drawing of the bones of the skeleton, left side. About $\frac{1}{30}$ natural size.

Plate XIV.

Fig. 3. Right side of specimen. Front limb and outline of abdomen painted in. Section of abdomen cut through showing reverse epidermal impression of left side. About $\frac{1}{30}$ natural size.

Fig. 4. Outline drawing of the bones of the skeleton, right side. About $\frac{1}{30}$ natural size.

Plate XV.

Fig. 5. Detail photograph of anterior section of skeleton, left side.
Fig. 6. Detail photograph of mid-section of skeleton, left side.

Plate XVI.

Fig. 8. Detail photograph from section of skeleton, right side.
Fig. 9. Detail photograph of anterior section of skeleton, right side.

Plate XVII.

Fig. 7. Detail photograph of distal end of tail. A, left side; B, right side.

Fig. 10. Detail photograph of anterior section of tail, right side, showing ischio-caudal and cloacle sphincter muscles.

Plate XVIII.

Fig. 11. Detail photograph of reverse impression of abdominal section of the left side.

Plate XIX.

Fig. 12. Detail photograph of skin overlying fourth trochanter, inner side of left femur, shown on the right side.

Fig. 13. Detail photograph of rows of large conical plates and smaller intervening tubercles underlying ischium, right side of skeleton.

Plate XX.

Fig. 14. Detail photograph of pads and skin of left foot, left side of skeleton.

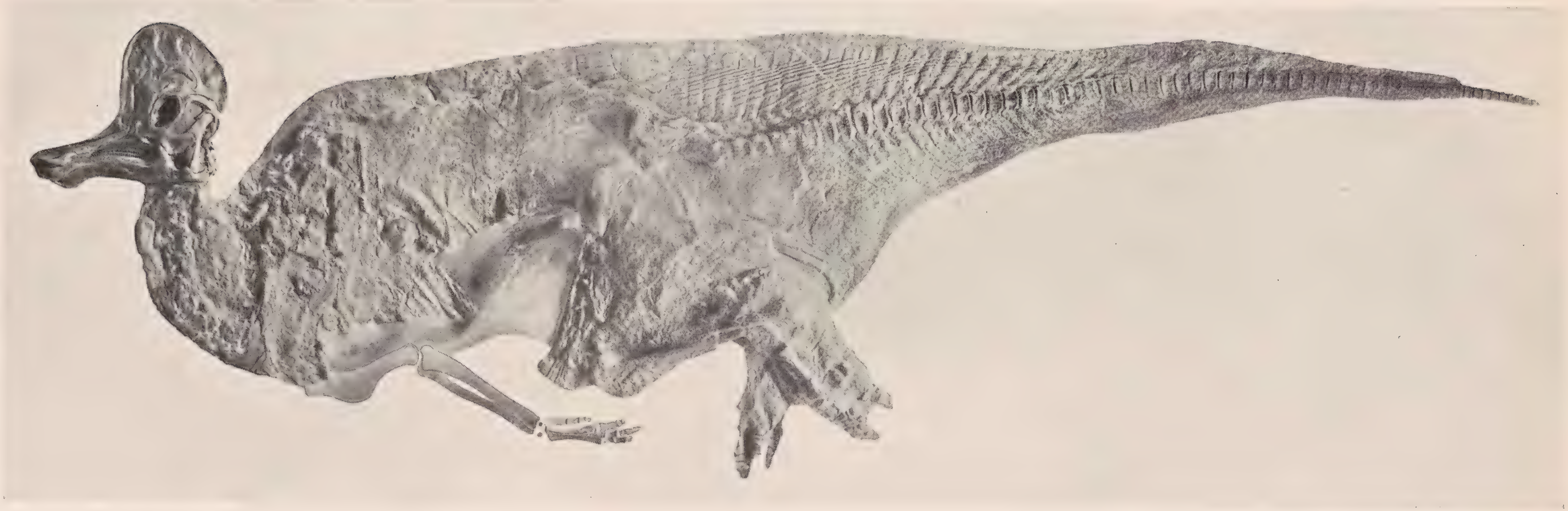
Plate XXI.

Fig. 15. Restoration of *Corythosaurus casuarius*. Drawn by Richard Deckert.

Plate XXII.

Fig. 16. Belly River marsh scene, showing typical foliage and Trachodonts. (1) *Corythosaurus*, (2) *Trachodon*, (3) *Kritosaurus*.

1



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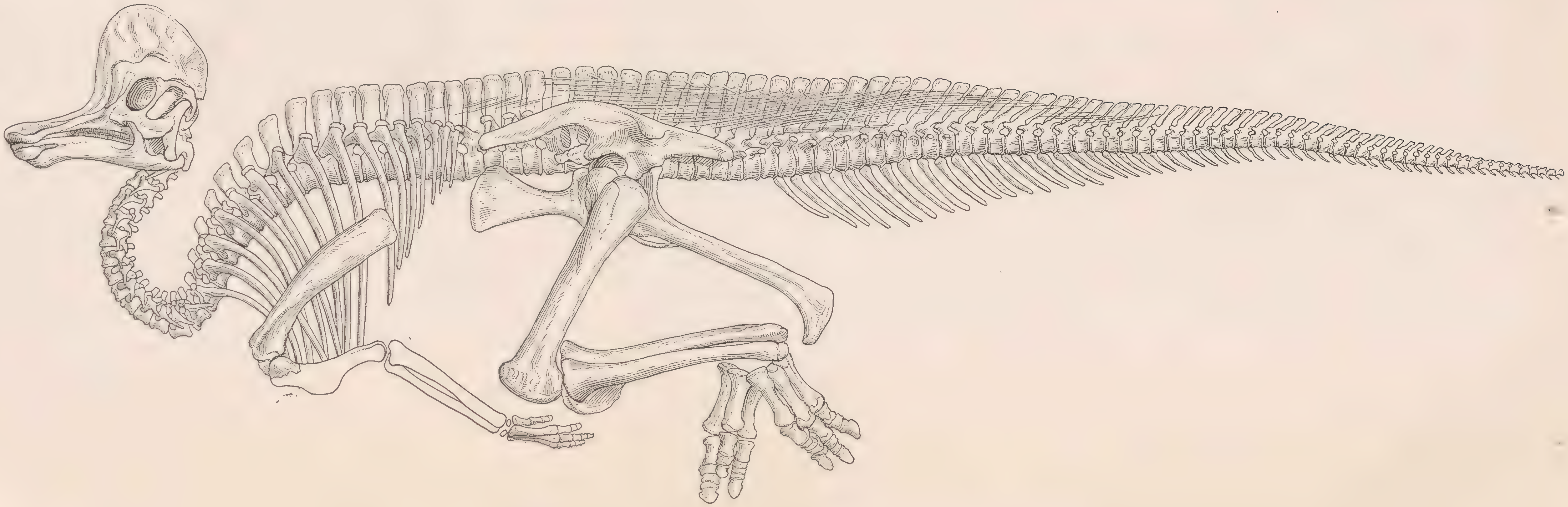

Figs. 1 and 2. Corythosaurus casuarius *Brown*.

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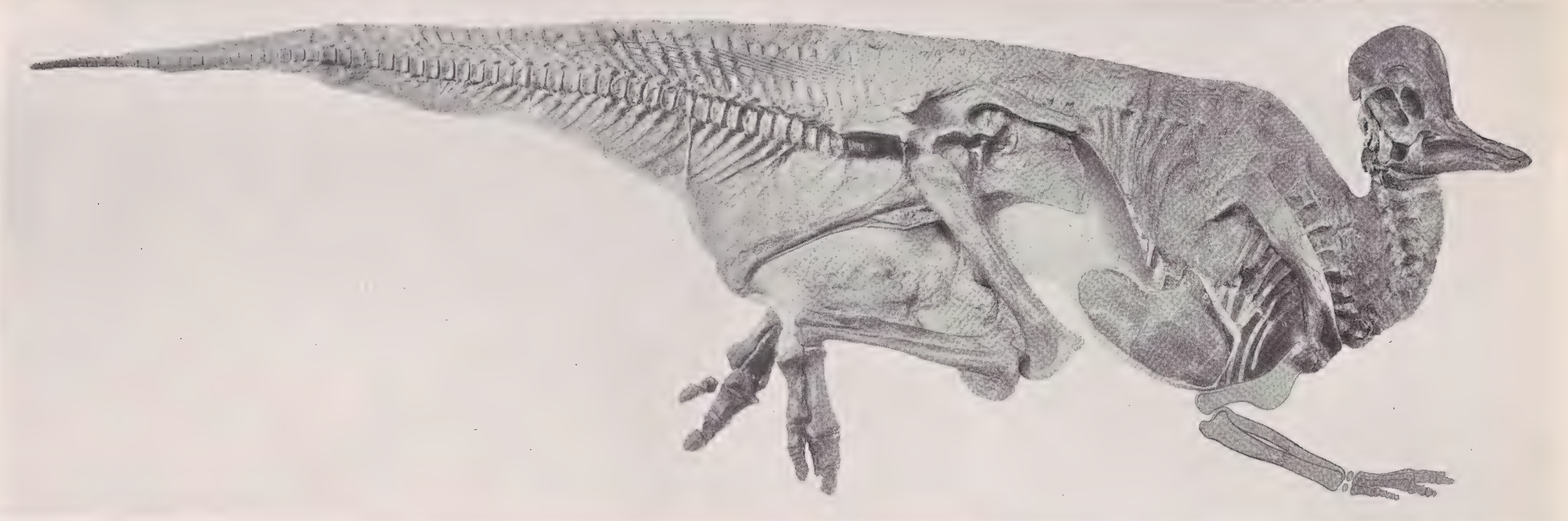

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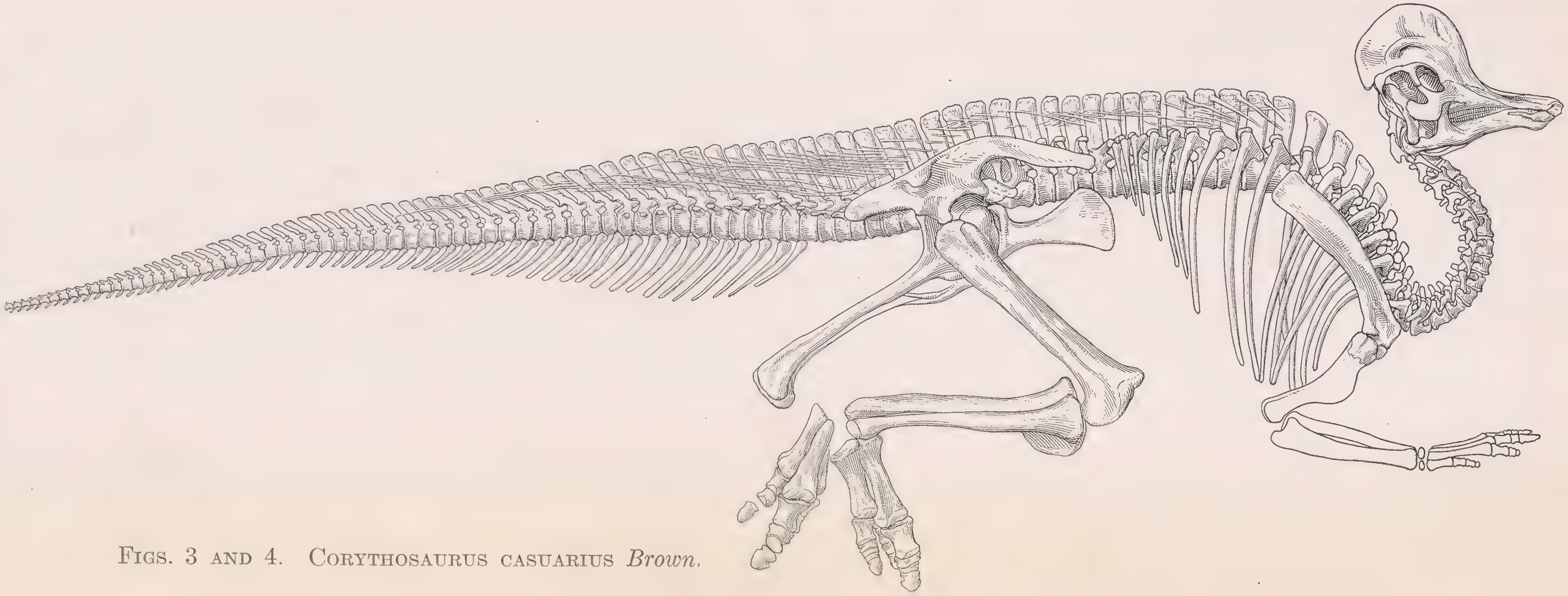
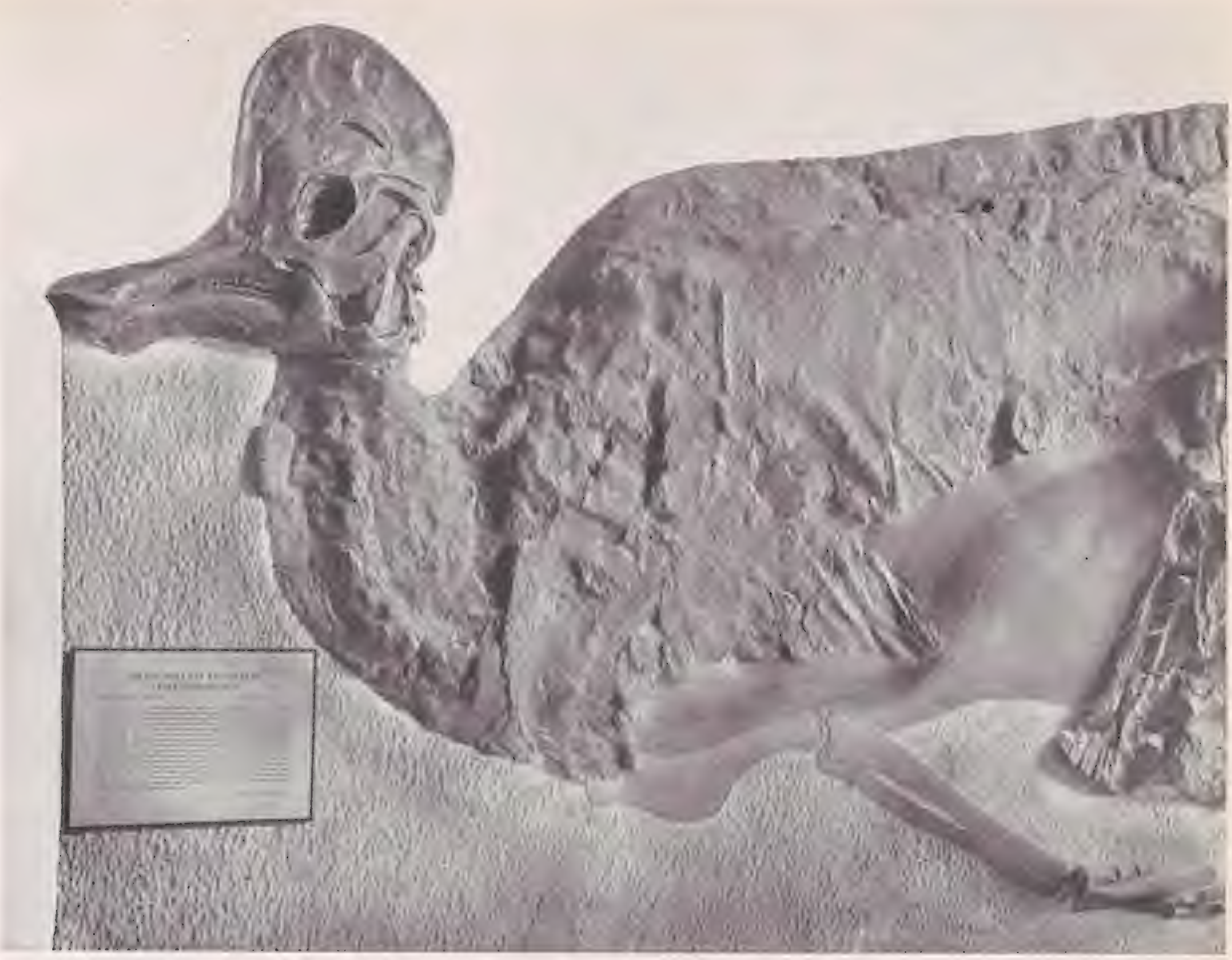


Figs. 3 and 4. Corythosaurus casuarius *Brown.*



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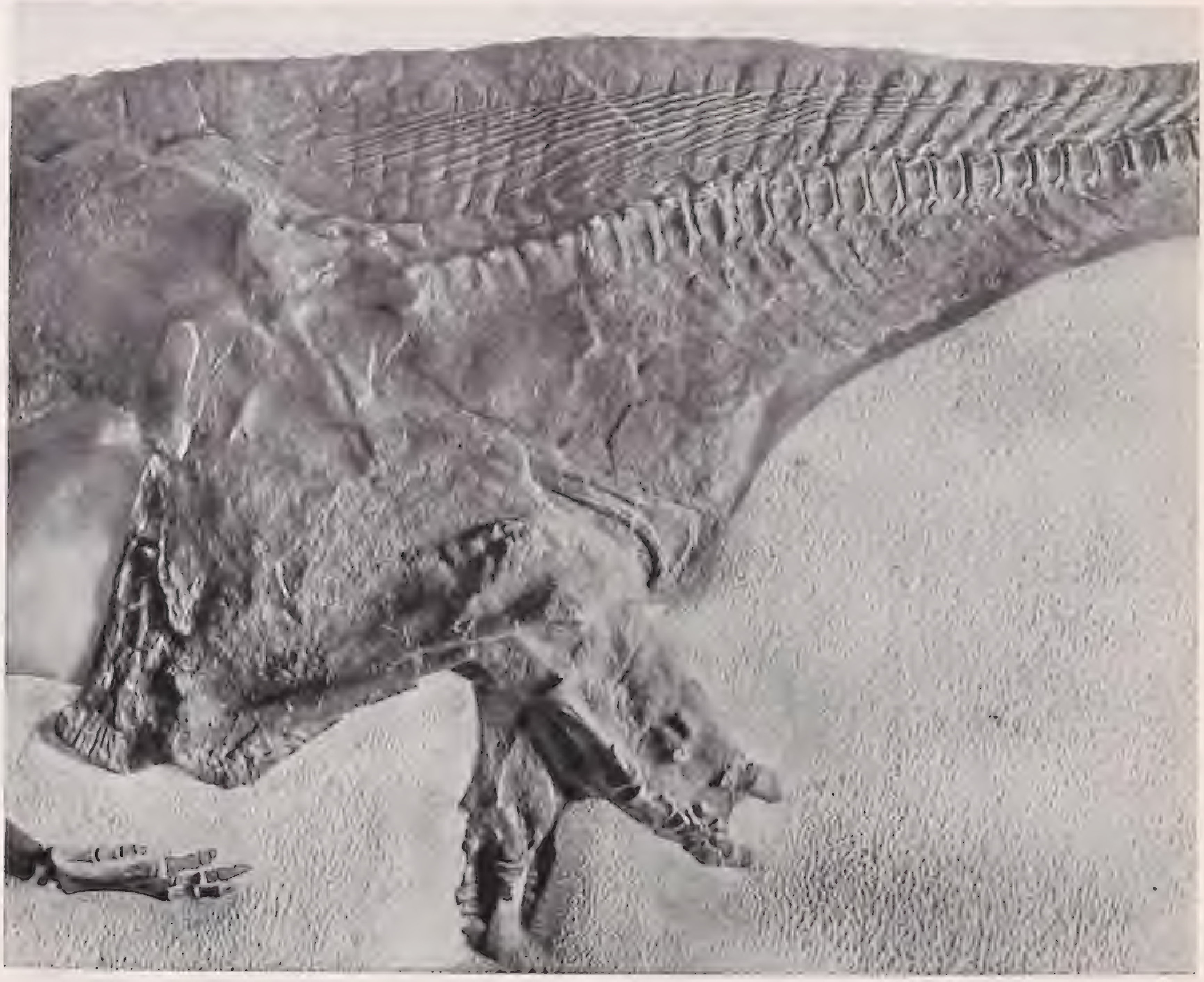

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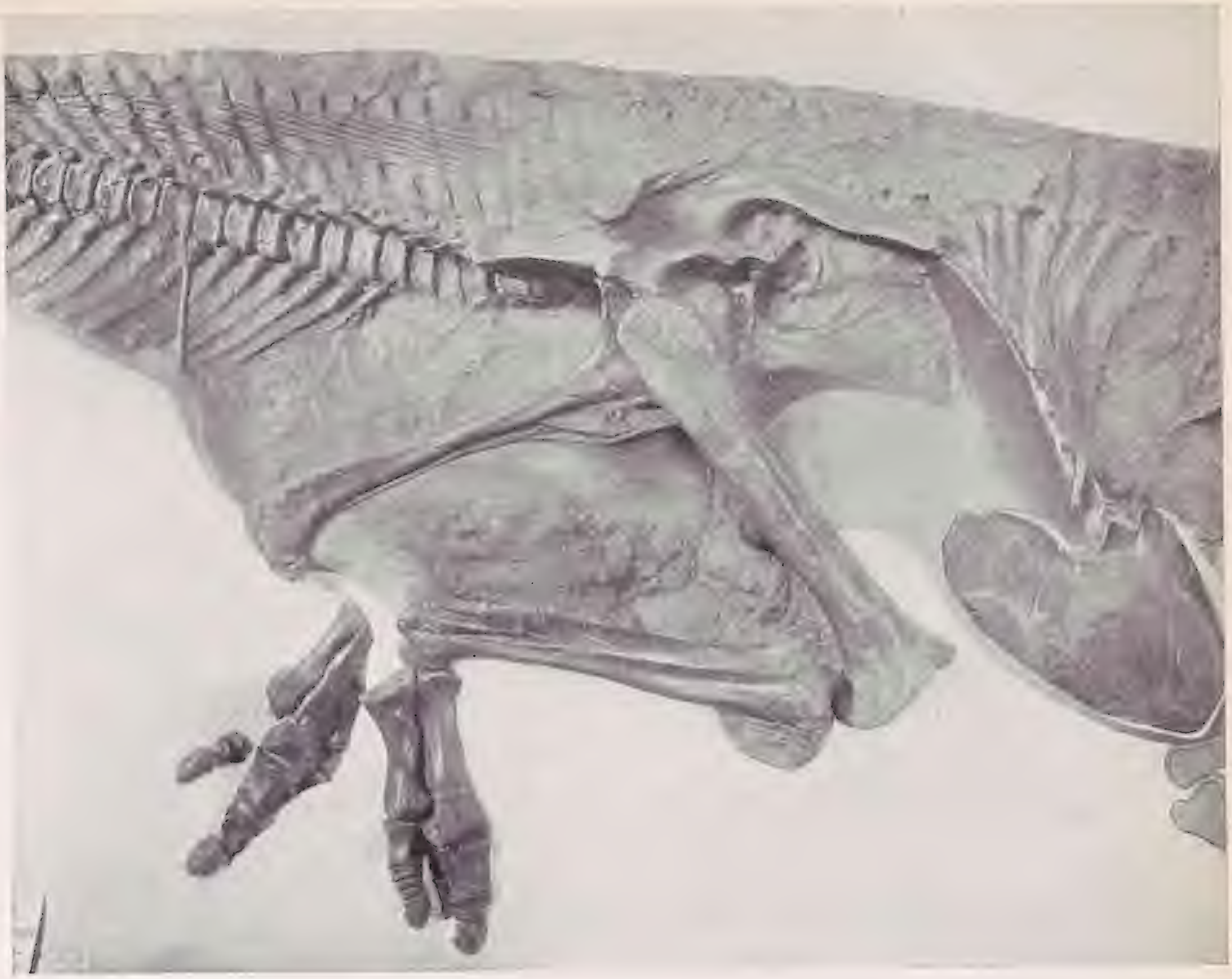
FIGS. 5 AND 6. CORYTHOSAURUS CASUARIUS *Brown.*



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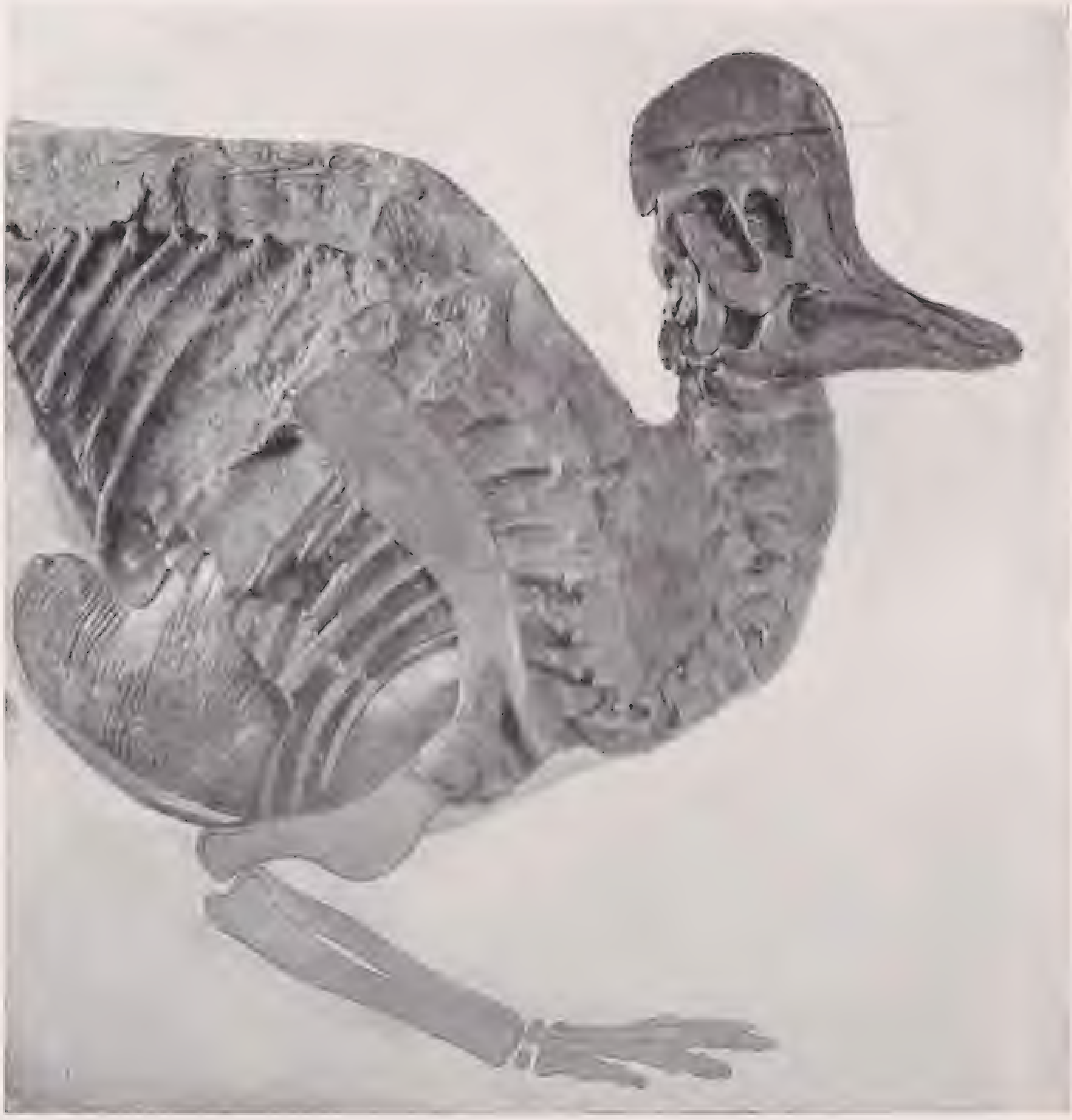

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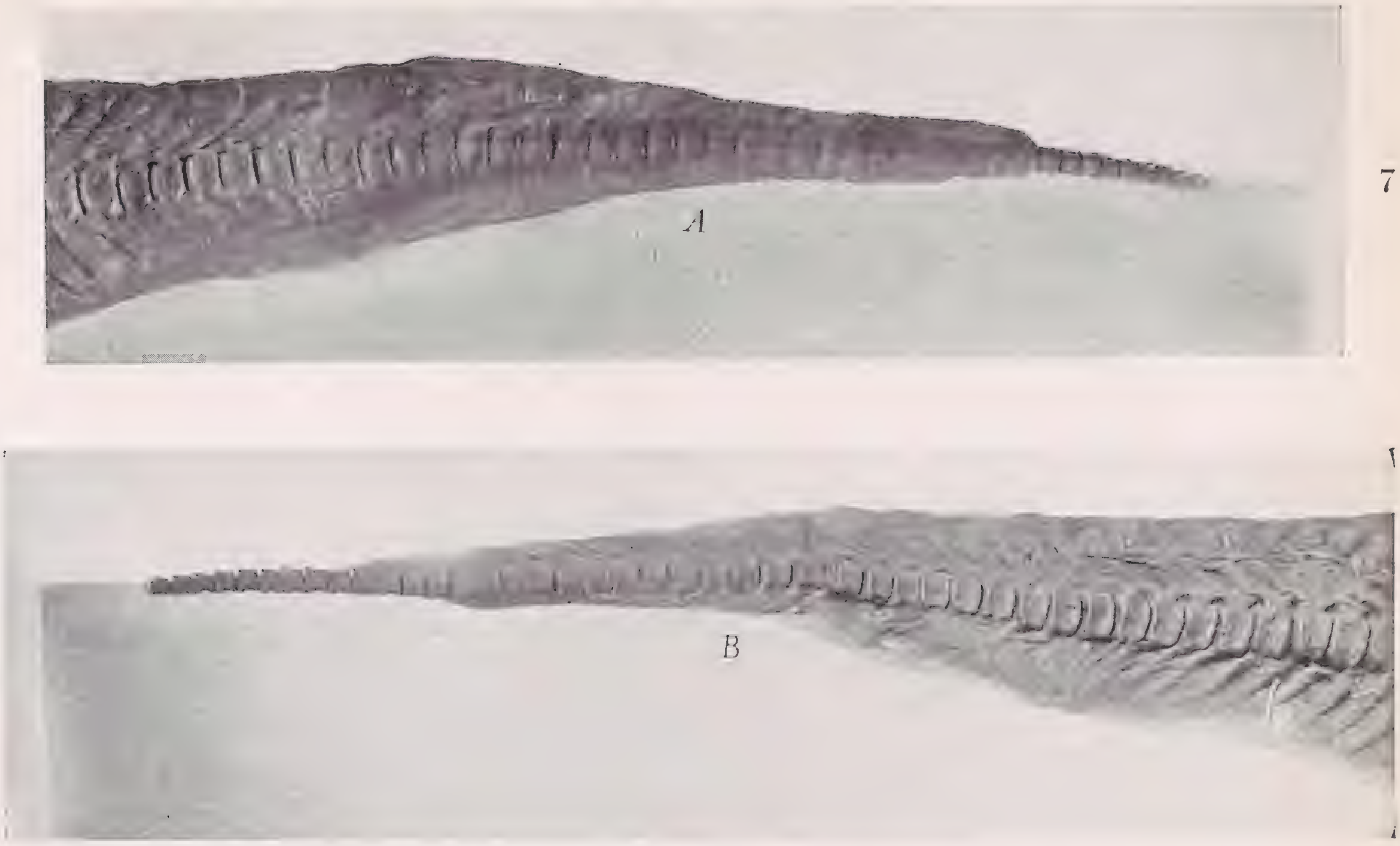
Figs. 8 and 9. Corythosaurus casuarius *Brown.*



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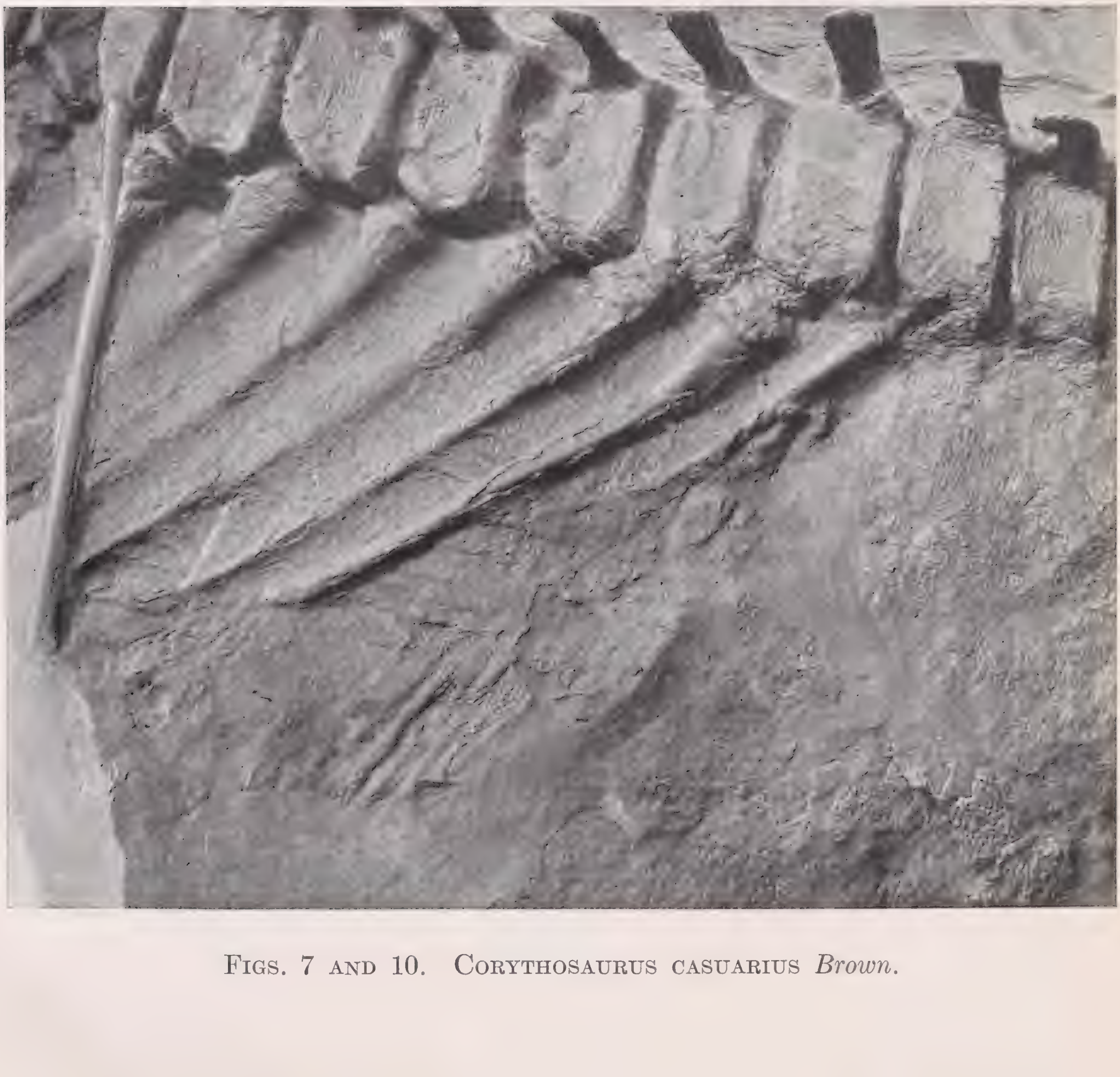

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FIGS. 7 AND 10. CORYTHOSAURUS CASUARIUS *Brown*.

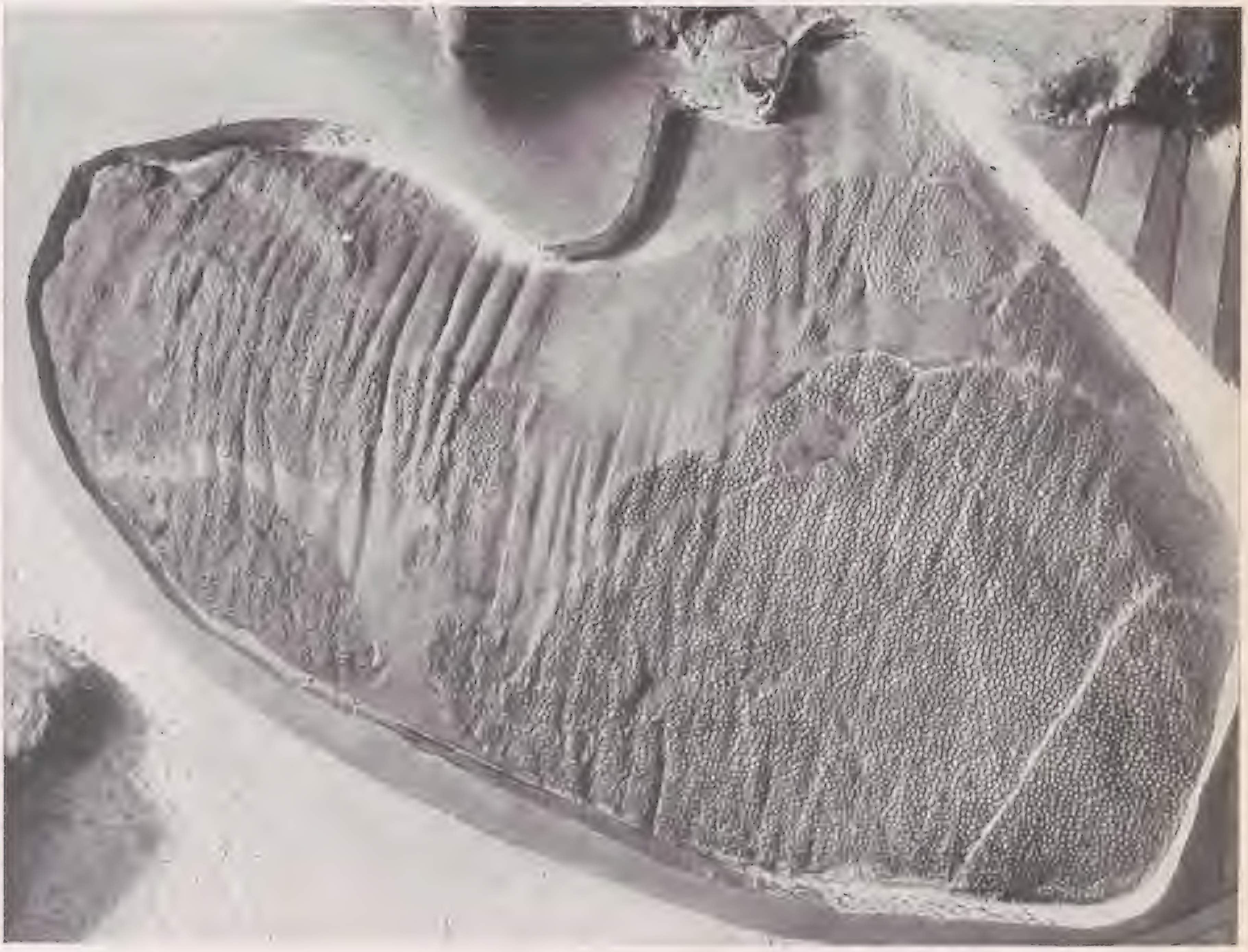
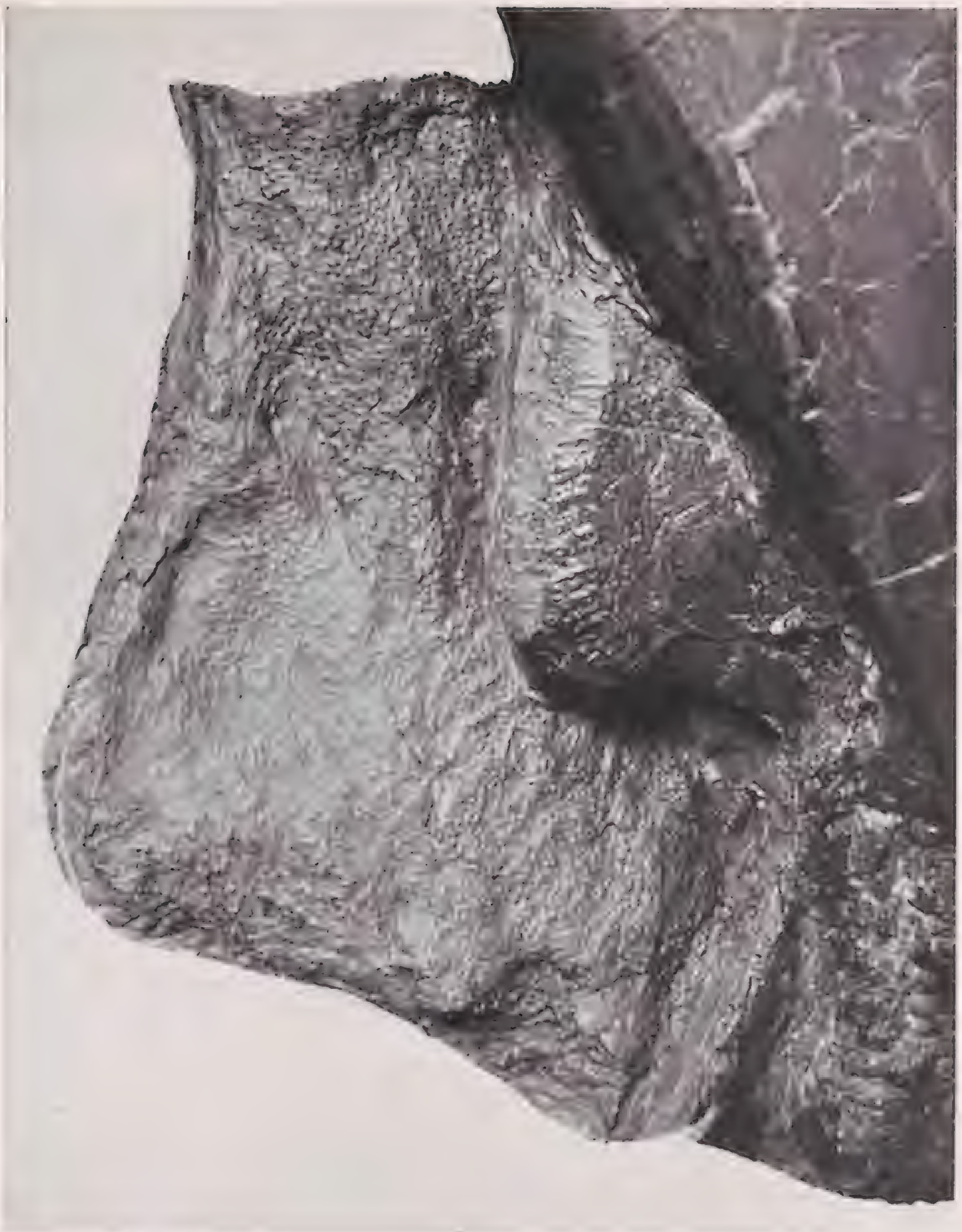


FIG. 11. CORYTHOSAURUS CASUARIUS *Brown.*



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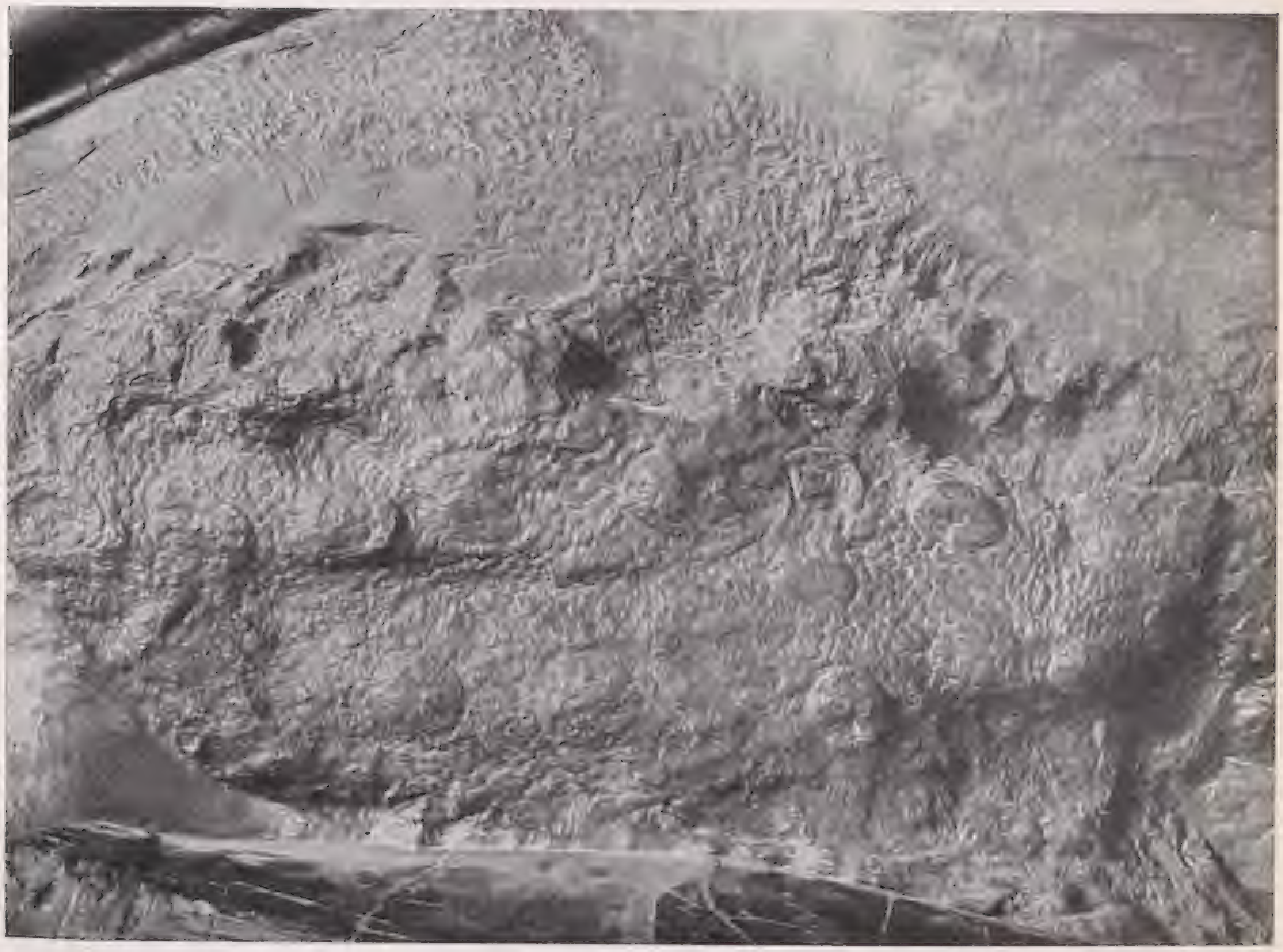

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Figs. 12 and 13. Corythosaurus casuarius *Brown*.

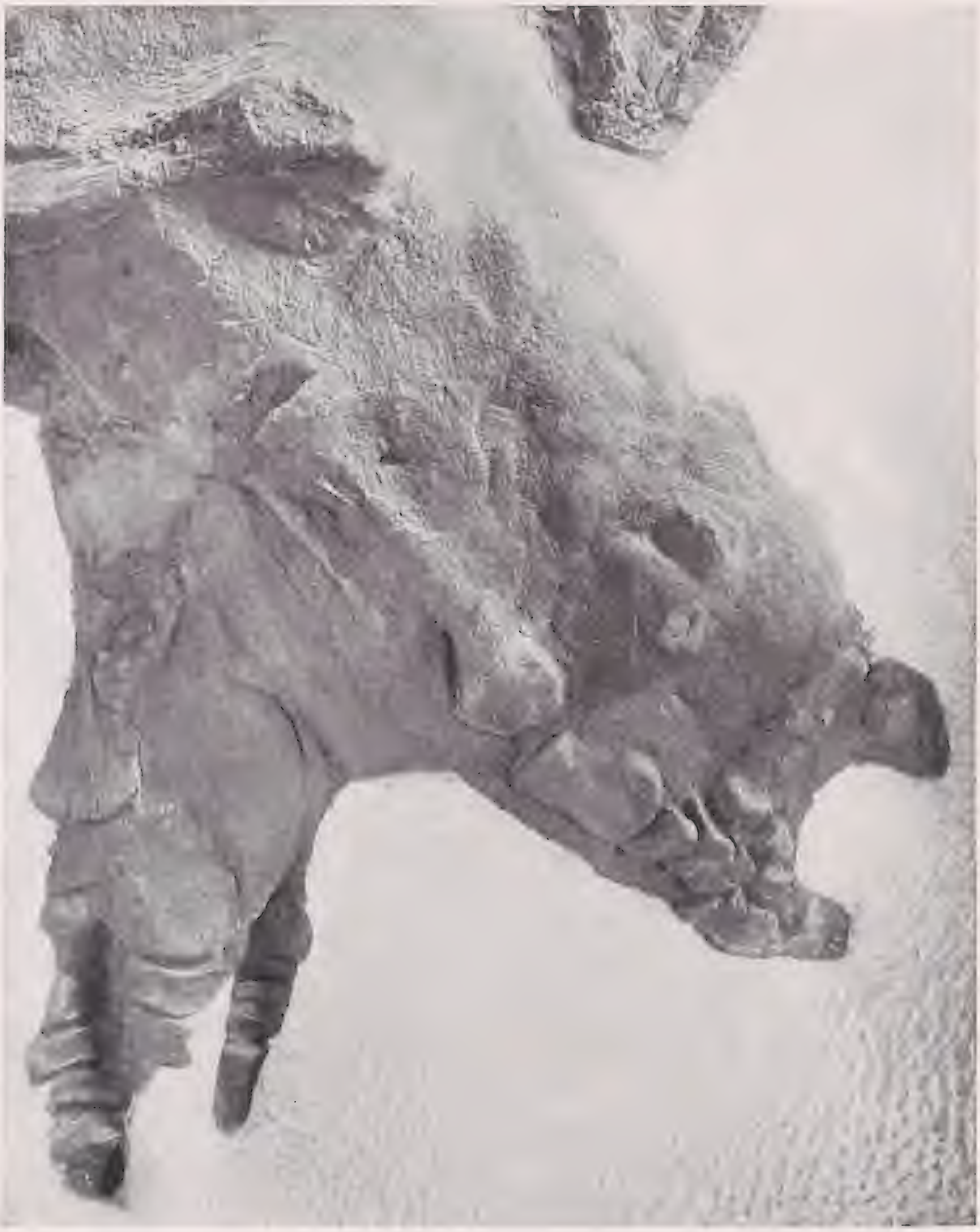

FIG. 14. CORYTHOSAURUS CASUARIUS *Brown*.

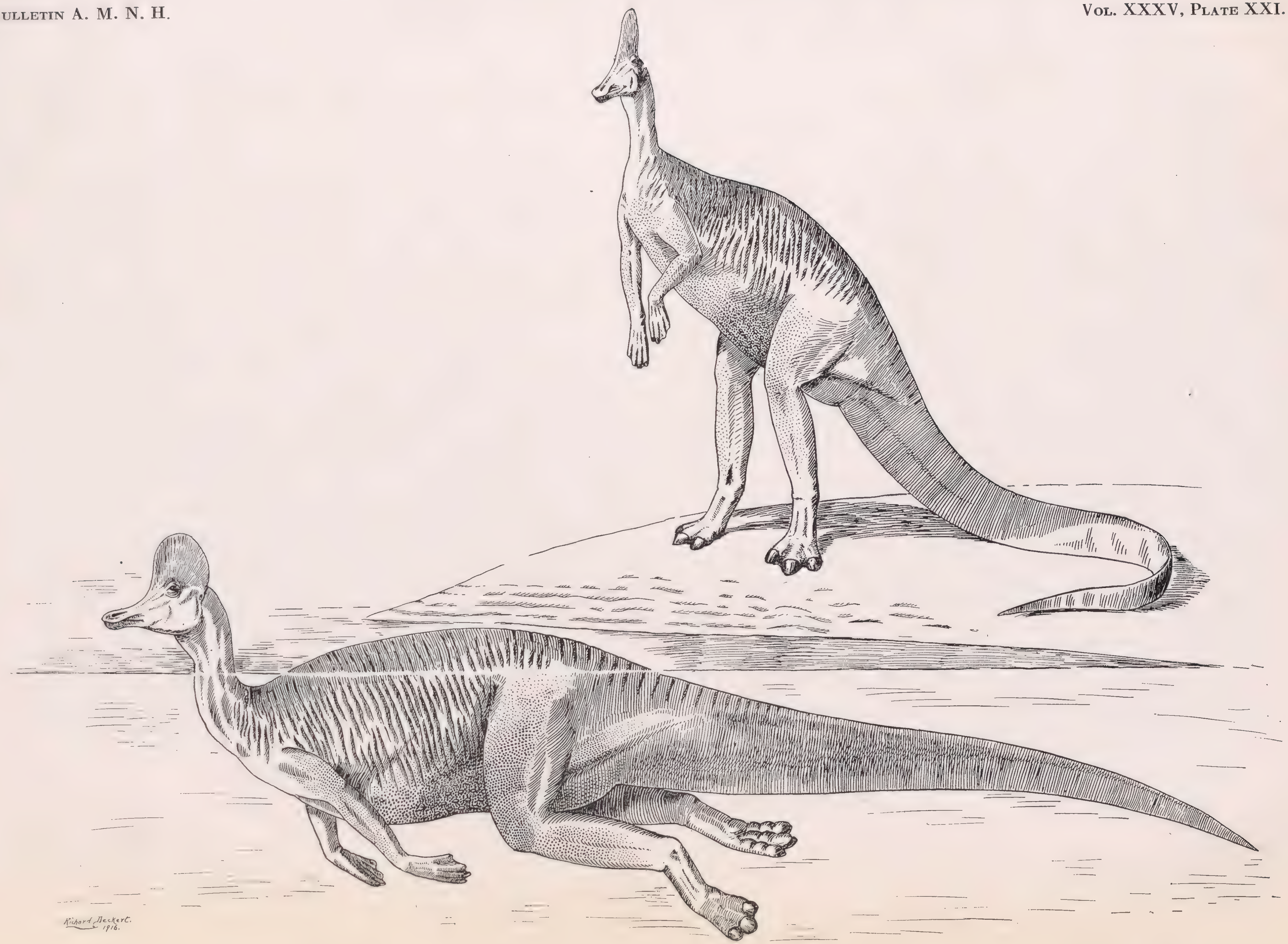
Richard Deckert 1916.

FIG. 15. RESTORATION OF CORYTHOSAURUS CASUARIUS *Brown*.

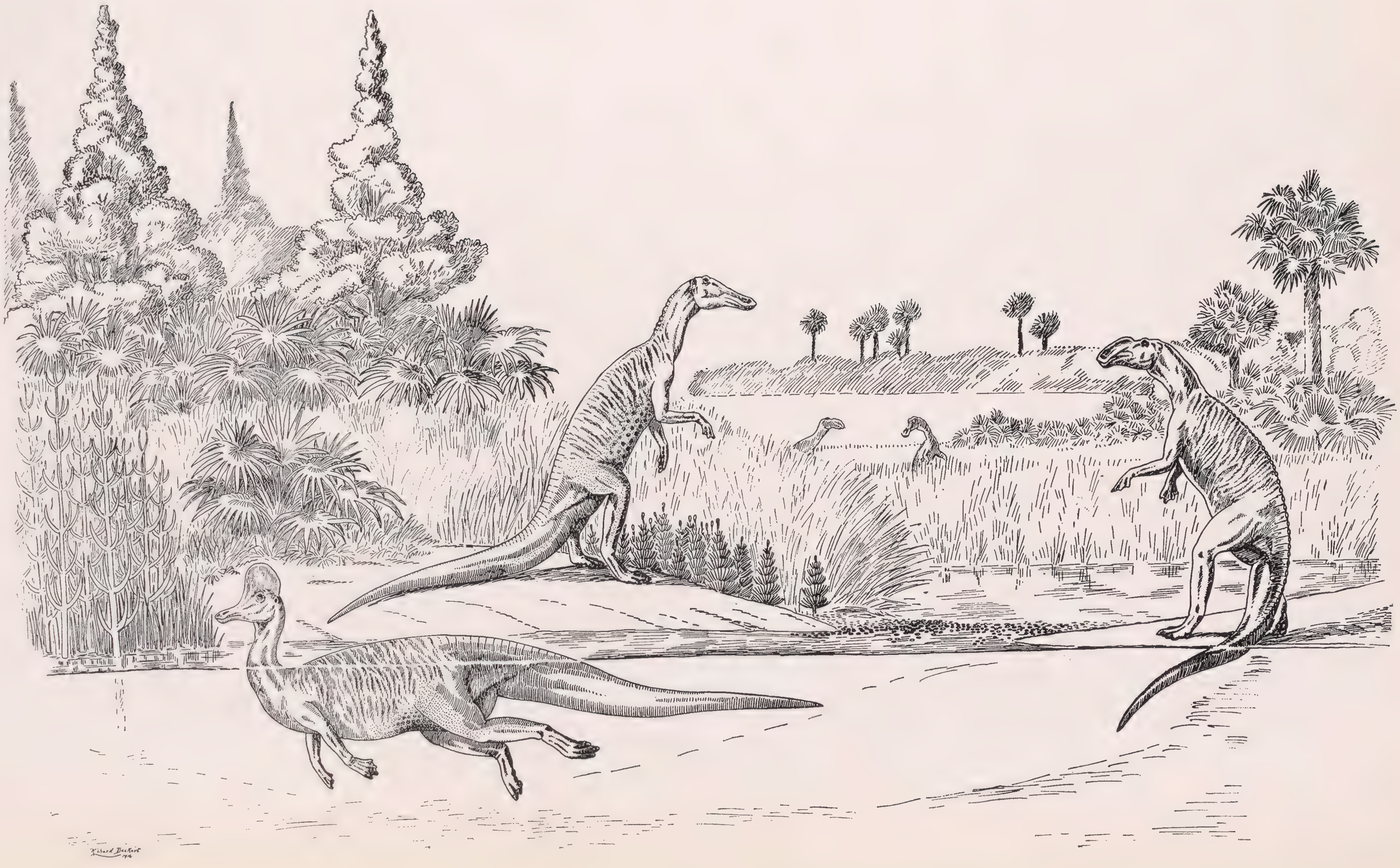

Fig. 16. Restoration of Corythosaurus casuarius *Brown.*

59.57.92 E

Article XXXIX.—THREE NEW SPECIES OF EVANIIDÆ.[1]

By Charles T. Brues.

While examining a collection of Evaniidæ belonging to the American Museum of Natural History, in connection with some other material of the same family, I have found three species hitherto undescribed. The types of two of these are in the American Museum.

Evania carinata sp. nov.

♂. Length 6.5 mm. Entirely black, except for a rufous spot on each mandible, and the palpi, which are dark fuscous. Head above antennæ rugose-punctate; face more rugose-reticulate, with the punctures less distinct; face with a distinct median elevation or ridge extending from the base of the antennæ to near the clypeus; clypeus bluntly pointed, smooth at tip; cheeks separated from the face by a strong curved carina that extends upward on the face for a short distance along the inner eye-margin; no transverse ridge in front of the base of the antennæ; cheeks confluently punctate above, finely punctulate below; head behind eyes rugose-punctate. Inner eye-margins divergent below; ocelli in a triangle, posterior ones twice as far from one another as from the eye-margin. Antennæ inserted a little below the middle of the eye; scape four times as long as the pedicel; both together a trifle longer than the third joint; fourth to sixth joints growing slightly shorter, the fourth nearly as long as the third. Mesonotum coarsely and rather sparsely punctate, the punctures few and widely separated outside the parapsidal furrows, which are distinct. Scutellum with similar, but closely placed punctures. Propodeum reticulated above. Pleuræ and mesosternum confluently punctate; mesopleura smooth above. Metasternal process long, twice as long as broad at middle, scarcely widened apically, with a very strong median carina for its whole length; processes short, scarcely divergent. Hind coxæ punctate. Abdominal petiole deeply, obliquely striate, smooth medially at the extreme base. Wings hyaline; basal vein widely separated from the subcosta, interstitial with the nervulus; cubitus and subdiscoideus wanting beyond the cells. Legs very short, the hind ones, including the coxæ, considerably less than twice as long as the body; middle tibiæ spinulose; hind tibiæ and hind tarsi more strongly so. Longer spur of hind tibia slightly less than half as long as the metatarsus.

Type: One specimen from Moorea, Tahiti. (McTavish Collection.)

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[1] Contributions from the Entomological Laboratory, Bussey Institution, Harvard University, No. 122.

This species is near *rugosiceps* Kieff. but the face is pubescent and not distinctly longitudinally rugose, the mesopleuræ below are strongly pubescent, the hind coxæ coarsely punctate, and the petiole coarsely and but slightly obliquely striate. This is quite similar to *E. meraukensis* Cam. and *E. beauforti* Cam. from New Guinea. The clypeus is narrowed as in the latter, but the face has a median elevated line as in the former. The only Tahitian species, *E. curvinervis* Cam. is quite different from the present form.

Evania rubrofasciata sp. nov. (Fig. 1).

♀. Length 6.5 mm. Black; middle portion of antennæ fuscous, mandibles reddish at middle, palpi piceous or fuscous, thorax ferruginous behind the scutellum and mesopleura, fore and middle tarsi, and hind coxæ below on apical half, rufous. Temples smooth, impunctate; cheeks hardly one-third as long as the eye, smooth, impunctate; face sparsely and not coarsely punctate, with a minute tubercle at the middle, level with the lower eye-margin; face not separated from the cheeks, but with a short furrow extending upwards from the inner edge of the mandible, defining the lateral edge of the clypeus. Eye-margins parallel; antennal basin with a sharp ridge separating it from the face. Antennal scape nearly as long as the three following joints; pedicel one-third as long as the first flagellar joint which is one-half longer than the second. Occiput smooth, sparsely and lightly punctate; ocelli large, in a flat triangle, distinctly closer to one another than to the eye-margin. Head everywhere strongly clothed with white pubescence. Prothorax at the humeri closely and rather coarsely punctate, propleuræ smooth above, coarsely rugose below. Mesonotum with sparse, not very coarse punctures; parapsidal furrows deeply impressed; scutellum sparsely punctate like the mesonotum; propodeum coarsely and regularly reticulate. Mesopleura smooth above, with widely separated very large punctures below; mesosternum closely and less coarsely punctate; metapleura with large round punctures below, reticulate above; metasternum closely, but irregularly punctate, its process with long, curved and strongly divergent prongs (Fig. 1, b). Middle coxæ twice their length from the hind ones which are smooth above, sparsely punctate on the sides and closely so below. Entire thorax, especially the pleuræ, thickly white pubescent. Legs rather long; hind tibiæ and tarsi spinulose, the spinules black; longer spur of hind tibia one-third the length of the metatarsus; claws slender, acutely toothed before apex. Wings (Fig. 1, a) brownish hyaline; basal vein weakly curved, nearly parallel with the subcostal for most of its length; transverse cubitus and transverse discoidal veins interstitial; radial cell longer than usual and but little widened apically. Petiole of abdomen smooth above, below with about half a dozen transverse ridges on the apical third, body of abdomen smooth.

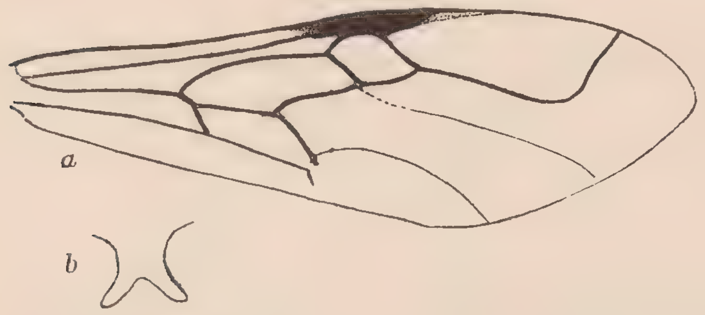

Fig. 1. Wing of *Evania rubrofasciata* sp. nov.

♂. Differs from the female in its more dense white pubescence and in having a distinct shallow longitudinal depression on the face on each side of the median line; these converge above near the base of the antennæ and separate below to meet the impressed lines at the sides of the clypeus. Scape of antennæ two-thirds as long as the first flagellar joint; pedicel transverse; second and third flagellar joints subequal, each one-fourth shorter than the first. Ocelli much enlarged.

A male and female from Walajanagar, North Arcot District, India (A. P. Nathan).

This species is colored much like *E. stenochela* Kieff., but structurally close to *E. nurseana* Cam. to which it will run in Kieffer's key to the Oriental species.[1] The spinules on the tibiæ and tarsi are distinct, but weak, especially in the male.

Chalcidopterella manni sp. nov.

♀. Length 3 mm. Black, with ferruginous markings. Head black above the antennæ, yellowish ferruginous below; scape of antennæ brownish-yellow, prothorax, mesonotum, scutellum and mesopleuræ ferruginous, remainder of thorax black; petiole of abdomen fuscous, with apical third yellow; body of abdomen black, fuscous toward tip; four anterior legs brown, hind pair black; wings hyaline. Head smooth behind the ocelli; front deeply punctate, the punctures well separated, some very large, with smaller ones intermixed; face more closely punctate, the punctures more or less confluent; extending upwards from the lateral margin of the clypeus is a deep, curved impression that extends halfway from the base of the mandible to the lower edge of the eye; these separate a convex median area from the sides of the face; cheeks separated from the face by a fine grooved line; malar space three-fifths the length of the eye; cheeks with a few well-separated punctures; head behind the eyes smooth and polished, with a very few irregular punctures, mainly near the eye margin. Antennæ inserted just below the middle of the eyes; strongly thickened toward apex; scape as long as the three following joints, second and third joints of nearly equal size, third slightly longer; sixth and seventh joints becoming much wider, seventh to tenth but little longer than wide. Ocelli in a low triangle, the posterior ones as far from one another as from the eye margin; eyes rather small, elongate-oval, bare. Mesonotum with distinct parapsidal furrows, coarsely, deeply and separately punctured; scutellum sculptured like the mesonotum; propodeum above regularly punctate-reticulate, with a small smooth elevation just before the insertion of the petiole; posterior surface with large, shallow, hexagonal reticulations, faintly concave medially. Mesopleuræ coarsely confluently punctate below, elsewhere smooth except for a single row of large punctures above; metapleuræ with very large confluent punctures; sides of propodeum with large oblong reticulations below and more or less hexagonal ones above. Petiole of abdomen as long as the distance from the tegulæ to its point of insertion, smooth except for irregular, scattered, more or less elongate punctures on the sides, especially toward the base. Legs short and stout, without spinules on the tibiæ or tarsi, spurs of hind tibiæ stout, differing only slightly in length, the longer one two-thirds as long as the metatarsus. Wings with only a narrow, closed subcostal cell; apex of submedian vein indicated as a short dash or chitinized fleck, elsewhere entirely absent.

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[1] Das Tierreich, Lief. 30, p. 67. (1912).

One specimen collected by Dr. W. M. Mann at Manneville, Haiti.

This form is readily distinguished from any other known species. The presence of a chitinous fleck, indicating the apex of the submedian vein would place it as a member of the genus *Evaniellus* Enderlein which contains a single Peruvian species. This seems to be a very trivial character upon which to base a genus, however, and I have placed the Haitian form in *Chalcidopterella,* from the members of which it is otherwise not separable.

56.9.72T(1181:72)

Article XL.—TWO NEW OLIGOCENE TITANOTHERES.

By Henry Fairfield Osborn.

In the revision of the Oligocene titanotheres for the United States Geological Survey Monograph of this group, with the coöperation of Dr. William K. Gregory, the types of two new important species have been discovered which previously have been referred erroneously.

These are the skull referred by Marsh to *Brontotherium gigas* and a jaw referred by Cope to *Symborodon acer*. The generic and specific reference in both cases is erroneous; the former specimen belongs to the genus *Allops* Marsh, the latter specimen to the genus *Megacerops* Leidy.

Allops walcotti *sp. nov.*

Type Locality and Geologic Level.— "Big Badlands," South Dakota, probably Corral Draw. Titanotherium zone, lower beds.

Type.— A nearly complete skull in the National Museum (No. 4260, skull Q). J. B. Hatcher collector.

Specific characters.— Premolars with small tetartocones; p^1–m^3 .285; incisors $\frac{2}{0}$. Horns elongate oval, no connecting crest; nasals elongate, broad; face relatively elongate. Mesaticephalic.

The type skull of this species (U. S. Nat. Mus. No. 4260), from level A, is narrow and elongate, partly owing to lateral crushing. This feature conceals its resemblance to *Allops marshi*, which is apparent in other features, namely: (1) primitive, long nasals; (2) horns primitively short and obliquely oval; (3) large lateral incisor (i_2) and small first (i_1), or median, incisor; (4) premolars accelerated, tetartocones more advanced than in *Brontops robustus* of level C.

Comparative Measurements.

	P^1–m^3	P^1–p^4	M^1–m^3	Pmx–cond.	Nasal length	Horn length	P^4ap×tr	M^3ap×tr
Allops walcotti type	285	112	169	640	105	100	35×51	60×61
Menodus heloceras A.M. 14576	265		170	603	132	070		
Brontops brachycephalus N.M. 4940	265	101	160			102	32×51	62×70
Brontops brachycephalus N.M. 4261	280	104e	178	580		085	33×53	68×73

Observations on the Measurements of Allops walcotti.— The type and only known specimen of this species exhibits the following comparison in measurements with skulls of *B. brachycephalus* and *Menodus* (*Titanotherium*) *heloceras,* which show that the type of *Allops walcotti* has relatively large premolars and small molars.

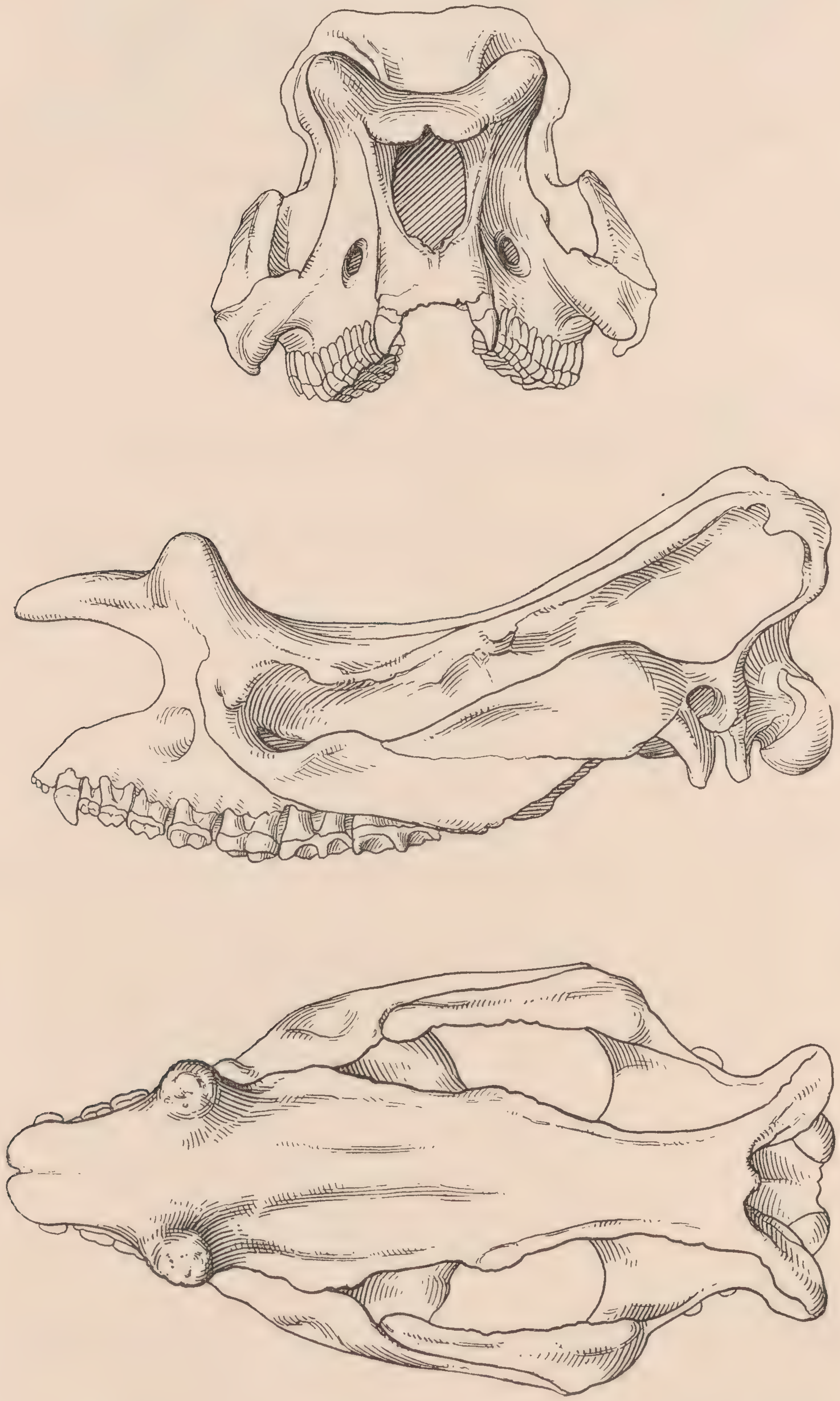

Fig. 1. Type skull of *Allops walcotti* Osborn, U. S. Nat. Mus. No. 4260. Figure copied from Plate XI entitled "Brontotherium gigas" of Marsh's proposed monograph on the Brontotheriidæ. One-eighth natural size.

The skull is crushed laterally, but it probably had a low zygomatic index, that is, it was mesaticephalic. While the reference to *Allops* requires confirmation its nearer affinities appear to be with this genus rather than with *Brontops* or *Menodus*. The external cingula of the premolars are not so sharply defined as in other primitive members of the menodontine group.

The species is named in honor of the Secretary of the Smithsonian Institution, Charles D. Walcott.

Megacerops riggsi *sp. nov.*

Type Locality and Geologic Level.— Northeastern Colorado, Horsetail Creek, Titanotherium zone (?upper beds).

Type.— A nearly complete lower jaw in the American Museum, No. 6364, E. D. Cope collector.

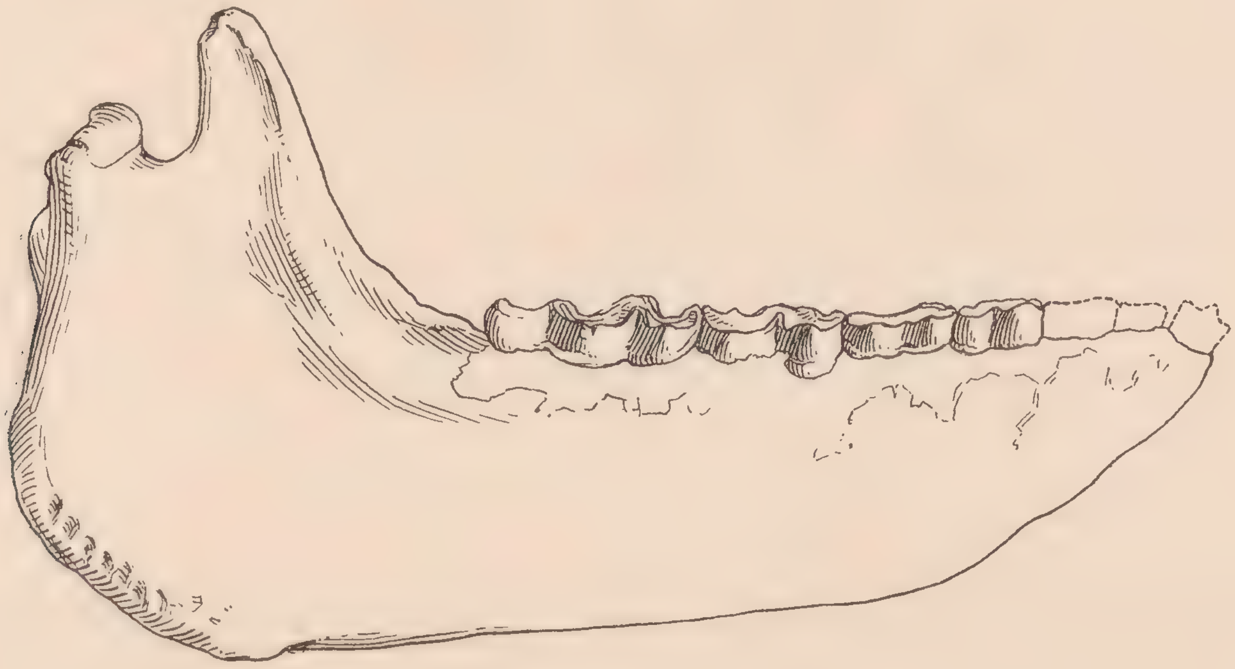

Fig. 2. Type jaw of *Megacerops riggsi* Osborn, Amer. Mus. Cope Coll. No. 6364. Jaw referred by Cope to *Symborodon acer* Cope, Pl. lxxxviii, fig. 1, of Cope's unpublished monograph "Tertiary Vertebrata, Part II." One-sixth natural size.

Specific characters.— (1) Of small size, smaller than any known individual of *Megacerops* or *Brontotherium*. (2) A very massive jaw with a small coronoid process and a very short symphysis. (3) Premolar series greatly abbreviated (.085). (4) Premolars and molars with reduced external cingula.

Measurements of Type.

Length of jaw, symphysis to condyle	465 (estimated)
" " premolar-molar series (p_1–m_3)	282
" " premolar series (p_1–p_4)	085
" " molar series (m_1–m_3)	194

The type of this species, named in honor of Mr. E. S. Riggs of the Field Museum of Natural History in recognition of his discoveries of Eocene titanotheres, is a jaw in the Cope Collection (Amer. Mus. Cope Coll. No. 6364) which was wrongly referred by Cope to his species "*Symborodon*" *acer*. It represents a highly specialized and small form of *Megacerops*.

56.9,33N

Article XLI.—PRELIMINARY DIAGNOSIS OF AN APPARENTLY NEW FAMILY OF INSECTIVORES.

By H. E. Anthony.

Plate XXIII.

In July, 1916, while searching for remains of fossil mammals in Porto Rico, in accordance with the plan for a natural history survey of the Island, a most interesting type of insectivore was discovered. A hint of its presence had been given in 1915 when fragments of two mandibles were sent in with the material collected by Dr. Franz Boas,[1] but this material was too incomplete to give any clue as to the exact nature of the animal. The first satisfactory specimen, a practically complete cranium, was found by the author's wife, Edith I. Anthony, in the Cueva Clara, near Morovis, July 19, 1916. Later, July 29, an abundance of material was secured in a cave more or less well known as the Cathedral Cave (Cueva Catedral) about two miles from Cueva Clara. Owing to the time that will be needed to thoroughly work up the results of this expedition, I am putting this insectivore on record in a preliminary paper with the intention of writing more fully at a later period.

The author desires to express his appreciation of the assistance and valuable counsel given him in the study of this animal by Dr. W. D. Matthew and Dr. W. K. Gregory of the Department of Vertebrate Palæontology and by Dr. J. A. Allen, Curator of the Department of Mammalogy and Ornithology.

Nesophontes[2] **edithæ** gen. et sp. nov.

Type, No. 14174, Dept. Vert. Pal., from the Cueva Catedral, near Morovis, Porto Rico, July 29, 1916; collector, H. E. Anthony. The type skull is nearly perfect, being broken only at the extreme tip of the premaxillaries and in the auditory region. The bone is dense and hard although brittle from age as is to be expected.

The skull is narrow and elongate, tapering gradually in width from the region of the squamosals to the end of the nasals. The entire superior outline is in practically the same plane, the frontals and parietals being but slightly raised above the nasals and occipital crest. The braincase is subcylindrical and somewhat inflated just back of the orbits. A very low sagittal crest is present and the lambdoidal crest is well developed. The interorbital region shows no noticeable constriction, having parallel margins and a rather flat transverse aspect. The nasal sutures cannot be traced but the rostrum is long and tube-like, being higher than wide. The zygomatic arch is incomplete, lacking the jugal, but the zygomatic roots on both the squamosal and the maxillary are present as distinct processes. There is a pair of well developed infraorbital foramina. The foramen magnum is proportionally very large. The interpterygoid fossa is well developed, being long and deep, but the pterygoid fossæ are reduced to obsolescence. The dentition is essentially of a primitive type and is represented by the formula, I., 3; C., 1; P., 3; M., 3. The incisors of a topotype (the type lacks three incisors) are ranged in nearly parallel rows, only slightly convergent anteriorly, which means that there is a noticeable diastema between the first incisors of each side. These teeth are slightly procumbent, especially the first, which is the largest. All are simple in structure being sharp and subconical. The canine is two-rooted, long and dagger-like, almost straight, and concave on the inner side. The first and second premolars are simple and subequal; the third is submolariform and triangular in cross-section with a high sharp cusp on the outer margin. The three triangular molars all have sharp, well developed cusps, the first two being of equal size, the third rather smaller.[1] The tooth rows along the inner margins are practically parallel from the canine backward. The glenoid fossa is deep and extensive. The auditory region is incomplete in every skull now available and the present evidence is too inadequate to state that this form has or has not an osseous audital bulla. The palate is shallowly concave and there is a pair of small, separated incisive foramina.

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[1] For report on this material see Ann. New York Acad. Sci., Vol. XXVII, p. 193.

[2] *Nesophontes.*— From νῆσος, island and φόντης, a slayer; *edithæ*, in honor of the author's wife, Edith I. Anthony, who found the first skull and directed attention to the presence of the animal.

No mandible was found in unquestionable association with the type skull but a lower jaw selected as of proper size to match the cranium gives the following characters. The horizontal ramus of the mandible is curved evenly below throughout its entire length and the ascending ramus is broad and heavy. The coronoid process is prominently developed and there is a conspicuous falciform angular process. The condyle has an unusual aspect due to the oblique ventral position of the articulating surface. The insertion areas for the temporal and pterygoid muscles are well defined. The lower dentition is similar to the upper (I., 3; C., 1; P., 3; M., 3) with the exception that the last premolar is simple, not submolariform; there is probably no diastema between the first incisors of each side, and the molars are of typical tuberculo-sectorial form. The teeth of the lower row are well in contact with one another. There are two anterior dental foramina below pm_2 and pm_4 respectively.

Measurements.— Greatest length of cranium, 41 mm.; greatest breadth (across zygomatic roots on squamosals, 17 mm.; greatest breadth of braincase, 14.5 mm.; interorbital breadth, 8.5 mm.; width of rostrum (back of canines), 6.5 mm.; length of maxillary molar series, 12.5 mm.; greatest transverse extent of m^1, 3 mm.; palatal width at pm^4, 5 mm.; length of mandibular molar series, 13.5 mm.; greatest length of mandible, 28 mm.

There appears to be a great difference in size between sexes, unless later research establishes more than one species, the male presumably being the larger, and if this assumption proves correct, the type is a female. The type skull shows evidence of full maturity. Among the topotype material considerable individual variation is shown, some of the variation being correlated with the size difference and consequently may be due to sexual differentiation. Such a variation is the much greater development of the lambdoidal crest in a large skull fully fifty per cent larger than the type. The teeth do not apparently change much with wear, sharp cusps being prominent in every instance.

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[1] The details of the dentition will be more fully treated in the paper to follow.

Nesophontes has no evident close relationships with any known genus. Its characters are so strikingly different and of a nature so important that full justice may be done them only by the erection of a new family. The Porto Rican animal is a true insectivore, thus removing at once from consideration any member of the Carnivora or Creodonta to which groups some of the characters might prompt one at first to turn.

Among the Insectivora the characters of the dentition alone are sufficient to exclude the entire section of the Zalambdodonta[1] while for the same reason the Leptictidæ may not include *Nesophontes*. All the Zalambdodonta have specialized or modified incisors and canines contrasting with the primitive condition of these teeth in *Nesophontes* and also have a reduced metacone, the cusp that in *Nesophontes* is high and V-shaped.

From the Erinaceidæ *Nesophontes* is excluded by having tritubercular instead of quadritubercular upper molars, by normal or primitive instead of specialized incisors and canines, by the reduced number of premolars, 3 in *Nesophontes,* 4 in the Erinaceidæ, and by the loss of the zygomatic arch.

Compared with the Tupaiidæ, *Nesophontes* differs in the possession of molars with V-shaped metacone only, instead of both metacone and paracone, while the incisors and canines of the Tupaiidæ are much more specialized than in *Nesophontes*. In addition the latter lacks the postorbital ring and greatly expanded braincase of the Tupaiidæ.

Detailed characters well separate *Nesophontes* from the Eocene insectivores (figured in the 'Carnivora and Insectivora of the Bridger Basin' by Dr. W. D. Matthew) and will be fully set forth in a later paper.

Nesophontes may not be included with the *Talpidæ* because of the uninflated condition of the auditory and basicranial regions, so expanded in the *Talpidæ,* the primitive form of the skull, as opposed to the flattened and swollen braincase in the *Talpidæ,* and the far less specialized character of the incisors, canines, premolars and molars, which latter lack the long crowns, sharp V-shaped paracones and inwardly projecting metacones found in the *Talpidæ.*

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[1] For convenience the Zalambdodonta is taken to include the families Centetidæ, Potamogalidæ and Solenodontidæ, the Necrolestidæ and Chrysochloridæ being so very different in structure that they do not enter into consideration.

From the Soricidæ, *Nesophontes* is sufficiently differentiated by the non-falcate form of the upper incisors, by the normal or primitive form of the lower incisors, by the normal form of the canines, by the unreduced premolar series, by the lack of the postero-internal spurs found on the shrew molar, and by the large size of the last upper molar. The general contour of the skull is much less specialized than that of the shrew skull. However, the affinities of *Nesophontes* appear, on the whole, to connect the Nesophontidæ more closely to the Soricidæ than to other families.

Nesophontidæ fam. nov.

To summarize, *Nesophontes* represents a distinct family, apparently hitherto unknown, characterized by the combination of the following important structures.

Nearly complete, primitive dentition in parallel, closed rows. I., $\frac{3-3}{3-3}$; C., $\frac{1-1}{1-1}$; P., $\frac{3-3}{3-3}$; M., $\frac{3-3}{3-3}$; $= 40$. Canines in normal position, normally developed, two-rooted. Incisors smaller than canines with median diastema above. Upper molars triangular in cross-section, asymmetrically cusped, with V-shaped metacone but no paracone. Lower molars of extremely primitive tuberculo-sectorial type.

Zygomatic arch incomplete, malar absent, zygomatic roots peg-like.

Skull elongate, narrow, braincase but little expanded.

Basicranial region moderately elongate antero-posteriorly.

Palate completely ossified.

Pterygoid fossæ much reduced.

Mandibular condyle slightly oblique to the transverse plane, the articulating surface directed downward.

Judging from associated forms *Nesophontes* must have lived at least up into the late Pleistocene as mingled with the bones of this insectivore were found the remains of several genera of bats some of which are living on the island today, the species even being identical.

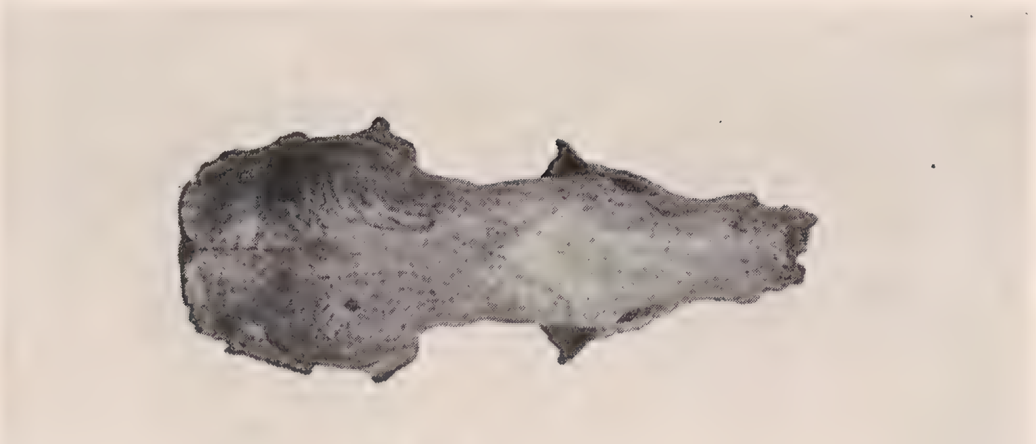

Fig. 1.

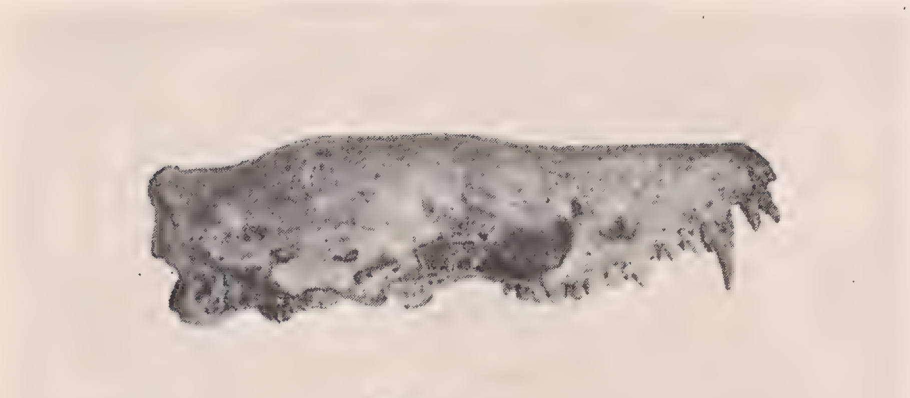

Fig. 2.

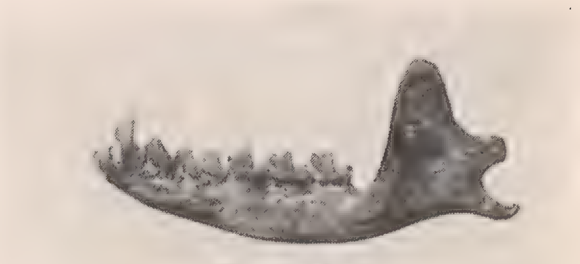

Fig. 4.

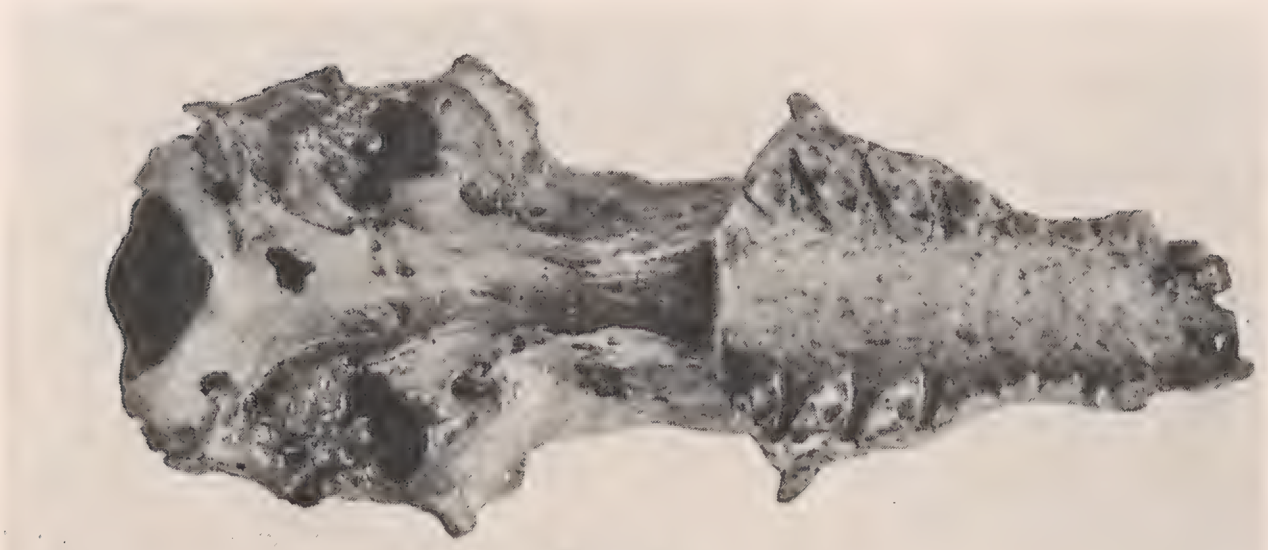

Fig. 3.

Nesophontes edithæ sp. nov.

Figs. 1, 2 and 4, natural size. Fig. 3 enlarged to about twice natural size, to show dentition.

59.57,99.A(7)

Article XLII.— NEW SPECIES OF THE BEE GENUS ANDRENA IN THE AMERICAN MUSEUM OF NATURAL HISTORY.

By Henry L. Viereck, Washington, D. C.

The following descriptions are contributions toward a monograph of the Pan-American species of *Andrena:*

Andrena (Andrena) beutenmuelleri, new species.

Type.— American Museum of Natural History, New York, N. Y.

Type locality.— Black Mountains, North Carolina, June. (Wm. Beutenmueller.)

Related to *A. perplexa* Smith, of which it may prove to be a race or variety.

Female.— Length 12 mm.; *head* black with pale ochreous pubescence that is almost white on the clypeus giving the latter a cinereous appearance on each side of a median bare band, malar space almost crowded out, the malar line apparently not more than half as long as the pedicel, clypeus moderately convex, finely reticulated all over, in addition closely punctured on each side of a narrow median impunctate reticulate band that is more conspicuously shining and less conspicuously reticulate on its lower third than the rest of the clypeus, most of the punctures of the clypeus at most a puncture width apart from each other, some of them adjoining, cheeks simple, without a keel, shining and finely sculptured, felted area of facial fovea almost parallel sided and ochreous, becoming attenuated below the middle and separated from the eye margin by a punctured, shining, elevated band, facial fovea apparently extending a little below a horizontal line drawn tangent to the upper edge of the clypeus, mandibles blackish castaneous beyond the middle and at the tip, average length of third joint of antennæ as long as or at most slightly longer than the next two joints combined, antennæ blackish brown throughout, labrarea almost semicircular, subtruncate, at least two and one-half times as wide at base as long down the middle; *thorax* black with pale pubescence, the pubescence on its dorsal surface and around the tubercles bright fulvous, pubescence of rest of thorax concolorous with that on the head, dorsulum sculptured like the clypeus, the punctures however not so close together, scutel punctured somewhat like the dorsulum, less reticulate and almost polished, fore legs, all coxæ, trochanters and femora with pubescence that is nearly concolorous with the pubescence of the head, mid-tibiæ and outer surface of mid-metatarsi with seal brown hairs, metatarsi of mid-legs and hind legs beyond the femora with bright fulvous hairs, hind tibiæ apically and hind metatarsi on the underside rather brownish stramineous to pale stramineous, brush on the inner side of hind metatarsi paler than the scopa, rather pale stramineous, hairs of the scopa loosely arranged and mostly simple, hairs at apex of hind femora and at base of hind tibæ dark brown, tegulæ and wing base blackish brown, wings strongly tinted with brown, the costa black, stigma pale brown, rest of veins dark brown, first recurrent vein received by the second cubital cell, nearer the second transverse cubitus than the first transverse cubitus is to the stigma on the radius, nervulus interstitial with the basal vein, decidedly arcuate and forming an acute angle with the first abscissa of the discoidal vein; *propodeum* with the apical half of its enclosure reticulate, its basal half rugose, almost plicate, a well developed line of demarkation between the enclosure and the rest of the propodeum which is reticulated and covered with scattered shallow pits, its pubescence concolorous with the pubescence of the pleuræ; *abdomen* black, almost polished, with the basal tergite and the depressed margins almost bare with fine scattered punctures, rest of abdomen sericeous with more distinct and more closely arranged punctures, anal fimbria bright fulvous, rest of abdomen with ochreous pubescence.

Andrena (Andrena) discolor, new species.

Type.— American Museum of Natural History, New York, N. Y.

Type locality.— Sierra Nevada, California.

Related to *A.* (*A.*) *novæangliæ* Viereck.

Female.— Length 9 mm.; *head* black, its pubescence pale ochreous except on the sides of the face, on the cheeks and on the vertex where it is black and in the foveæ where it is pale seal brown fading into whitish below the middle of the foveæ, clypeus virtually without a median impunctate band, convex, punctured and polished except laterally and basally where it is minutely reticulated, its punctures one to four or more puncture widths apart, felted area of facial foveæ forming an inverted cone in outline, its base almost adjoining the upper eye margin, a short distance below the upper eye margin it is separated for the rest of its length by a narrow, parallel sided, shining, punctured area, facial foveæ with the felted area extending to or a little below the antennal line on the left side, apparently a little shorter on the right side and at most half as wide or scarcely more than half as wide as the ocellocular line is long, mandibles with the apical half mostly castaneous, palpi typical, average length of the third joint of antennæ as long as or a trifle longer than the average length of next two joints combined, antennæ blackish brown, labrarea truncate, at least twice as broad at apex as long down the middle, at least two and one half times as wide at base as at apex; *thorax* black, with pale ochreous pubescence, dorsulum sculptured like the base of the clypeus, scutel sculptured like the dorsulum, metanotum more densely sculptured than the scutel, legs pubescent like the thorax except that the tarsi and fore and mid tibiæ are mostly covered with pale golden brown hairs, scopal hairs loosely arranged, stramineous, hind tibiæ and tarsi brownish stramineous, the former with dark hairs at base, hind femora at apex with seal brown hairs, tegulæ and wing base castaneous, stigma dark brown, veins brownish stramineous, subcosta blackish, membrane with a brownish stramineous tinge, first recurrent vein received by the second cubital cell at the middle or a little basad of the middle, nervulus interstitial with the basal vein and forming an acute angle with the first abscissa of the discoidal vein; *propodeum* sculptured like the base of the clypeus except in the enclosure where it is mostly finely reticulate and impunctate, the enclosure poorly defined; *abdomen* black without a metallic tinge, depressed portion of segments stramineous, abdomen shining and covered with indistinct, sparse, shallow setigerous punctures, the hair of the first and second tergites mostly rather erect and ochreous; on the rest of the tergum the hair is dark and erect except on the depressed margins where it is appressed and ochreous and in the fimbria where it is seal brown.

Andrena (Andrena) edwardsi, new species.

Type.— American Museum of Natural History, New York, N. Y.

Type locality.— Moscow Mountains, Idaho, July 8, 1898.

Has characters in common with *A.* (*A.*) *washingtoni* Cockerell, *A.* (*A.*) *milwaukeensis* Graenicher, and *A.* (*A.*) *hitei* Cockerell.

Female.— Length 8.5 mm.; *head* black, pubescence whitish except on the cheeks, vertex and sides of the face where it is blackish, facial line shorter than the transfacial line, malar space distinct, the elevated part thereof, however, indefinite, the depression in the malar space extending virtually to the eye margin, clypeus convex, polished, with a median impunctate band, with scattered punctures, the punctures nearer to each other along the basal and lateral margins along which the clypeus is also indistinctly reticulated, cheeks without a keel, shining and polished, felted area of facial fovea almost parallel sided with its ends rounded, almost adjoining the eye margin, only a shining line between, lower edge of the fovea extending distinctly below the antennal line and apparently on a line with the base of the clypeus and at least three-fourths as wide as the ocellocular line is long, mandibles with castaneous tips, glossa and palpi typical, average length of third joint of antennæ a little longer than average length of next two joints combined, antennæ blackish brown, labrarea broadly truncate though not distinctly so, not subemarginate and at least five times as wide at base as long down the middle, the truncature not much narrower than the labrarea is wide at base; *thorax* with its tegument and pubescence colored like the head, dorsulum sculptured like the clypeus and covered with white and black hairs that nowhere obscure the sculpture, scutel with white and black hairs, more sparsely punctured than the dorsulum and more extensively polished, metanotum dull and finely reticulated, with white hairs like the pleuræ, mesosternum with some black and some pale hairs, coxæ, trochanters and femora with pale pubescence, tibiæ and tarsi with seal brown hairs, brush on the under side of metatarsi appearing darker than the hair on the upper side, scopa blackish brown its hair loosely arranged and mostly simple, legs dark brown, tarsi beyond metatarsi and claws paler brown, hairs at apex and posteriorly on hind femora concolorous with the scopa or nearly so, tegulæ and wing base castaneous, stigma translucent brownish, veins somewhat darker than the stigma, subcosta black, second recurrent vein received by the second cubital cell nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus falling short of being interstitial with basal vein but forming an acute angle with the first abscissa of the discoidal vein, membrane distinctly brownish; *propodium* shining and finely reticulated like the metanotum, its enclosure poorly defined, propodeal floccus whitish; *abdomen* black, with the apical margins of the tergites brownish with a stramineous edge, without a metallic tinge, shining and covered with indefinite reticulations, first and second tergite with a few erect whitish hairs, rest of tergum with blackish or dark brown pubescence, anal fimbria dark seal brown.

Andrena (Andrena) idahorum, new species.

Type.— American Museum of Natural History, New York, N. Y.

Type locality.— Moscow Mountains, Idaho, July 8, 1898.

Has characters in common with *A.* (*A*) *edwardsii* Viereck, from the original description of which it differs as follows: Related to *A. perindotata* Viereck.

Female.— Length 12 mm., head with its pubescence including temples and foveæ, pale ochreous, depression of the malar space not extending virtually to the eye margin, the elevated portion, however, distinctly shorter than the depressed portion, clypeus with its middle third somewhat flattened, shining, with a narrow median impunctate welt with many of its punctures adjoining each other and apparently not nearer to each other along the margins except on the lateral margin of the lower half, clypeus reticulated in addition to being punctured along the basal and lateral margins, felted area of the facial foveæ parallel sided on its upper half but gradually narrowing to a rounded point on its lower half, a shining, sparsely punctured band between the fovea and the eye margin, apical half of mandibles mostly dark reddish, average length of third joint of antennæ apparently as long as the next two joints combined, labrarea distinctly broadly truncate, not subemarginate and at least three times as broad at base as long down the middle, its sides apparently as long as the truncature is wide; *thorax* with its dorsulum sculptured like the clypeus where the clypeus is punctured and reticulated, its pubescence uniformly pale ochreous, concolorous with the pubescence of the head and the rest of the thorax, scutel more densely sculptured than the dorsulum, not at all polished, sculpture of metanotum apparently even denser than that of the scutel, scopa pale ochreous, tarsi beyond metatarsi and claws also dark brown, concolorous with the metatarsi, hairs at apex and posteriorly on hind femora concolorous with the dark brown hairs on the upper side of the hind tibiæ at base, nervulus interstitial with the basal vein; *propodeum* dull and finely reticulated, its enclosure well defined, also with rugæ at its base; *abdomen* with its first and second tergites with some ochreous hairs, rest of tergum with dark brown hairs, anal fimbria bright seal brown.

56.81,9:14.71

Article XLIII.— SKELETAL ADAPTATIONS OF *ORNITHOLESTES, STRUTHIOMIMUS, TYRANNOSAURUS.*

By Henry Fairfield Osborn.

Plates XXIV–XXVII, and Twenty-three Text-figures.

Introduction.

A revision of the previous description by the author (1903) of *Ornitholestes* and a preliminary study of the skeletons of *Struthiomimus* (*Ornithomimus*) and of *Tyrannosaurus* forms the subject of this article.

The new subgeneric or generic name **Struthiomimus** is proposed for the Belly River (Fort Pierre) stage of the Ornithomimidæ.

The discovery of the skull of the Belly River "*Ornithomimus*" occasioned one of the greatest surprises in the whole history of vertebrate palæontology because it proved that both in head and limb structure this animal was non-raptorial. *Struthiomimus* (*Ornithomimus*) has no adaptations in its limbs nor in its jaws for seizing an active prey; on the contrary, the extremely small head and slender jaws entirely without teeth most nearly resemble those of the ostrich (*Struthio*). Nor is the recently discovered fore limb analogous to that of any of the carnivorous dinosaurs; it is in some characters like that of the peaceful herbivorous tree sloths *Bradypus* and *Cholœpus;* in other characters it is unique. The pes has long been known as of the purely cursorial type, the phalanges closely resembling those of certain of the struthious birds.

These surprising discoveries necessitate a reconsideration of the structure and habits of *Ornitholestes,* which at the time of its first description by Osborn derived its name from its supposed bird catching propensities (*Ornithos,* ὄρνις, bird, lestes, *λῃστήσ,* robber). *Ornitholestes,* an Upper Jurassic animal, is doubtless related as a family to *Struthiomimus* (*Ornithomimus*) of the Upper Cretaceous, there being a striking general resemblance, as shown in the comparative restorations of Plate XXV. *Ornitholestes* connects *Struthiomimus* (*Ornithomimus*) with the true carnivorous dinosaurs since it is more of the raptorial type. In the light of our fuller knowledge of the *Struthiomimus* (*Ornithomimus*) skeleton a restudy of *Ornitholestes* indicates that it also has partially lost its raptorial characters; the teeth are small and feeble, in the manus the two central digits, D II–III, are closely appressed and not adapted to seizing or holding a struggling live prey, as Osborn imagined in restoring this animal[1] as seizing *Archæopteryx;* the manus is relatively feeble, and the phalanges while not fully known appear to be elongating in the direction of the *Struthiomimus* (*Ornithomimus*) type. In brief, *Ornitholestes* is a small, subcarnivorous dinosaur of the cursorial, bipedal type, the body balanced by a very elongate tail which shows the beginnings of characters evolving for a new mode of life, in adaptation to which there appears to be a secondary elongation of the fore limb, which is carried to a further extreme in *Struthiomimus* (*Ornithomimus*).

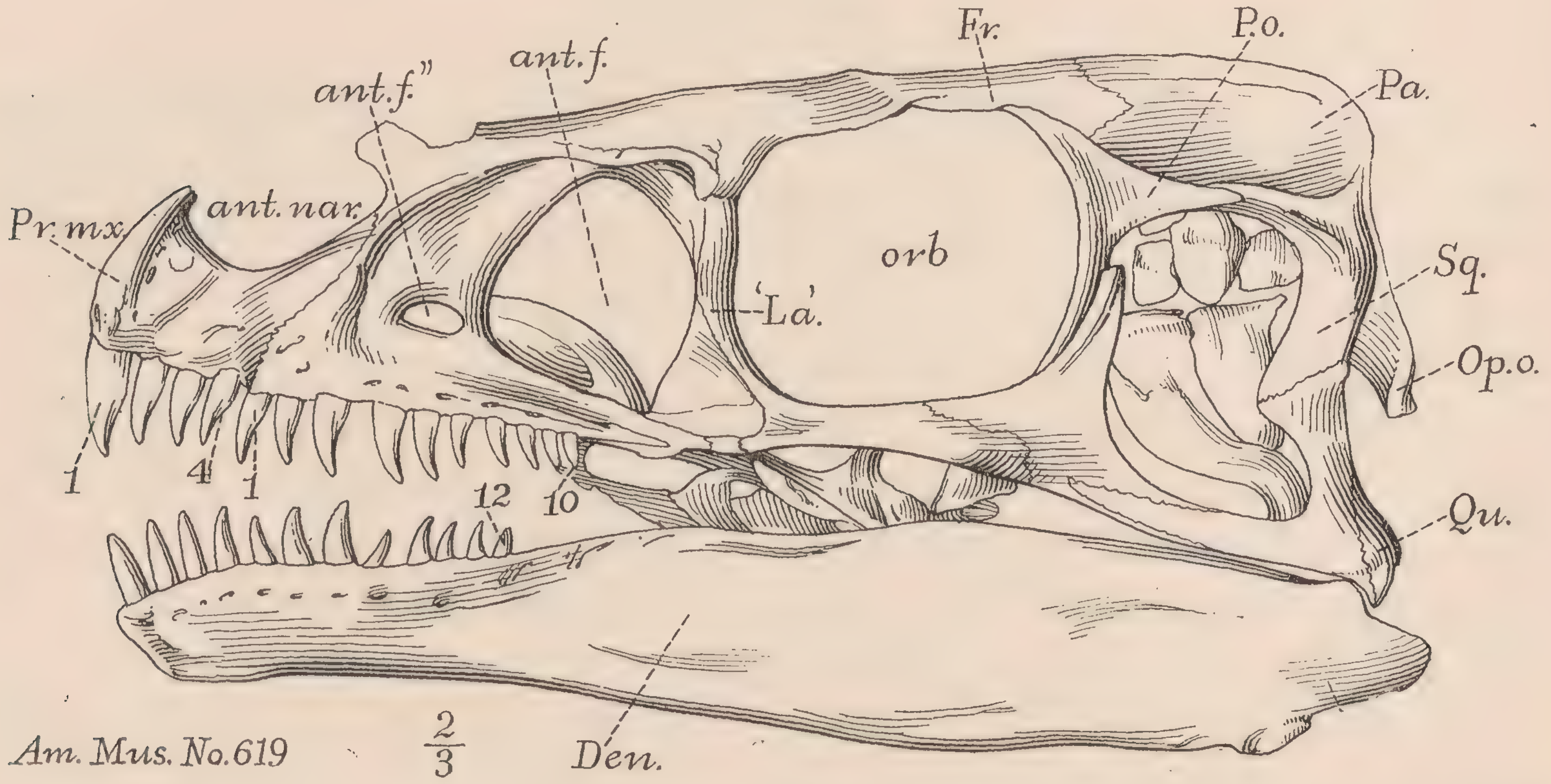

Fig. 1. Reconstructed skull of type of *Ornitholestes hermanni*, Amer. Mus. No. 619, replacing the original figure (1903). Two-thirds natural size.

Ornitholestes does not point directly toward the *Struthiomimus* type for it displays a somewhat different adaptive evolution of the manus. Yet *Ornitholestes* appears to agree with *Struthiomimus* in the separation or divergence of the phalanges of the pollex (Digit I) from those of Digits II, III, which are closely appressed (see Figs. 2, 3) to each other.

The illustrations for this bulletin have been made with great accuracy by Mr. Erwin S. Christman, Mrs. Lindsey Morris Sterling, and Mr. A. E. Anderson. The orthogonal scale projection of the vertebral column of *Tyrannosaurus* by Mr. Christman and the photographs by Mr. Anderson are especially accurate and remarkable.

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[1] Osborn, H. F. "Fossil Wonders of the West, the Dinosaurs of the Bone-Cabin Quarry, being the First Description of the Greatest "Find" of Extinct Animals Ever Made." Century Mag., Vol. LXVIII, No. 5, Sept., 1904, pp. 680–694.

RESTUDY OF *ORNITHOLESTES HERMANNI* OSBORN.

Text-figs. 1–3, Plate XXVI.

The original reconstruction of the skeleton (Osborn, 1903, fig. 1, p. 460)[1] is very inaccurate. It was based partly upon Marsh's restoration of the skeleton of *Anchisaurus*. The cervical ribs are incorrectly restored; the presacral vertebræ, restored as twenty-eight, are certainly too numerous; the digits of the manus (Osborn, 1903, figs. 1, 2, 3) are restored as spreading instead of closely appressed; the skull is incorrectly drawn.

The following characters may be pointed out in the new reconstruction shown in Plate XXVI, which is based upon a restudy of the type specimen (Amer. Mus. No. 619) supplemented by the manus of the second specimen (Amer. Mus. No. 587).

Vertebral formula. The vertebral formula is uncertain; it is estimated in comparison with that of other Theropoda as follows:

	Ornitholestes	*Struthiomimus*	*Allosaurus*	*Tyrannosaurus*
Cervicals	? 9	10	9e	10–9
Thoracic dorsals	?13	13	14	13–14
Cervico-thoracics, presacrals	23e	23	23	23
Sacrals	4	?5	5	5
Caudals	?39–44	?40		?53

It will be observed that there is a constant number of twenty-three pre-sacrals in *Struthiomimus*, *Allosaurus*,[2] and *Tyrannosaurus*, which renders it probable that *Ornitholestes* also had not more than twenty-three pre-sacrals.

The boundary line between the cervical and thoracic vertebræ in the American Museum skeleton of *Ornitholestes* is uncertain because the two vertebræ C9 and C10 are missing, but in *Struthiomimus*, in which the cervical series is complete, the boundary line is clearly indicated by the change in the character of the ribs from the fixed, coalesced condition (C10) to the movable bicipital condition (Th. 1).

Skull. (1) Teeth: premaxillary 4, maxillary 10; crowns not so serrate or prehensile as in typical carnivorous dinosaurs. (2) Cranium with two antorbital openings, prominent premaxillaries, typical theropod arrangement of lachrymals, frontals, postorbitals, parietals, squamosals, quadratojugals, opisthotics. (3) Dentary with twelve small upright or slightly recurved teeth. (4) Jaw with sessile coronoid process.

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[1] Osborn, H. F. "Ornitholestes hermanni, a New Compsognathoid Dinosaur from the Upper Jurassic." Bull. Amer. Mus. Nat. Hist., Vol. XIX, Art. xii, July 23, 1903, pp. 459–464.

[2] In the National Museum series of *Allosaurus* there were found nine cervicals, fourteen dorsals, and five sacrals; there were two breaks in the series, but evidently the whole number was present. Letter of C. W. Gilmore, January 8, 1916.

Vertebræ. Cervicals nine or ten in number, gently opisthocœlous; dorsals amphicœlous; caudals amphicœlous. The supposed 7th and 8th cervicals are moderately elongate, slightly opisthocœlous, with separate attachments for the capitulum of a freely articulated rib on the anterior portion of the centrum and for the tuberculum on the broad diapophysial extension of the neural arch. The neuro-central suture is faintly indicated. It appears that the cervical ribs were slender, free, and two-headed in *Ornitholestes* while in *Struthiomimus* they are firmly coalesced with the sides of the cervical centra and arches, a progressive character. For other details of the vertebræ see original description (Osborn, 1903, p. 460). Four firmly coalesced sacral ribs are suturally distinct. Caudals 39–44e, anterior caudal ribs coalesced. The very characteristic rod-like elongation of the zygapophyses of the caudal vertebræ begins with the vertebra supposed to be C13; it reaches its maximum between C16 and C24. In these vertebræ the chevrons are depressed, elongate, bifurcated in front, with a posterior keel. In *Struthiomimus* the rod-like elongation of the prezygapophyses begins with C12 and reaches the maximum in C26–C30, which are so rigidly articulated by the elongate zygapophyses and chevrons as to admit of little or no movement.

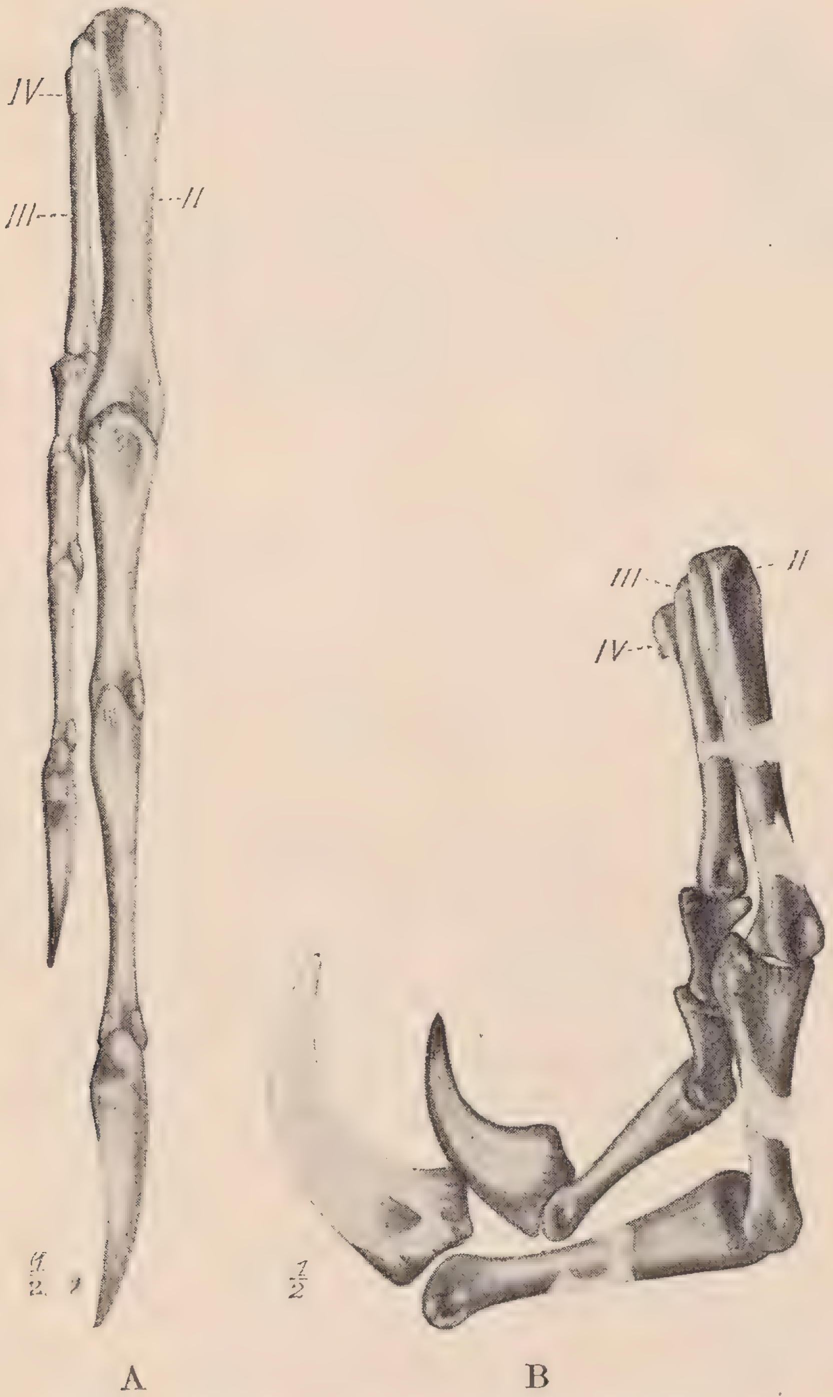

Fig. 2. Incomplete manus of *Ornitholestes hermanni;* Digit I is missing in this specimen. Amer. Mus. No. 587. Palmar (A) and internal (B) views, one-half natural size. After Osborn, 1903.

Pelvic girdle. The pelvic girdle is broadly similar in contour to that of *Struthiomimus,* but ilium, pubes, and ischia are suturally separate, while in *Struthiomimus* they are firmly coalesced; pubes with deep symphysial union; ischia more slender, with proximal anterior processes united distally; peduncle of pubes missing in the type.

Hind limb. Femur (.207m.) and tibia (.159m.) estimated to be of unequal length, the femur being the longest bone. In *Struthiomimus* the tibia is more elongate, a cursorial adaptation. The pes tridactyl; median metatarsal, Mts. III (.117 m.), relatively less elongate than in *Struthiomimus:* condition of Mts. V unknown. The total length of the hind limb is .483 m., the tibio-femoral ratio is .706, which indicates that the movement of this animal was not so swift as that of *Struthiomimus* (*Ornithomimus*), in which the tibio-femoral ratio is: 1.11 (T .540–F. 480). It appears from the preserved terminal phalanges that they were more recurved and claw-like than in *Struthiomimus* (*Ornithomimus*).

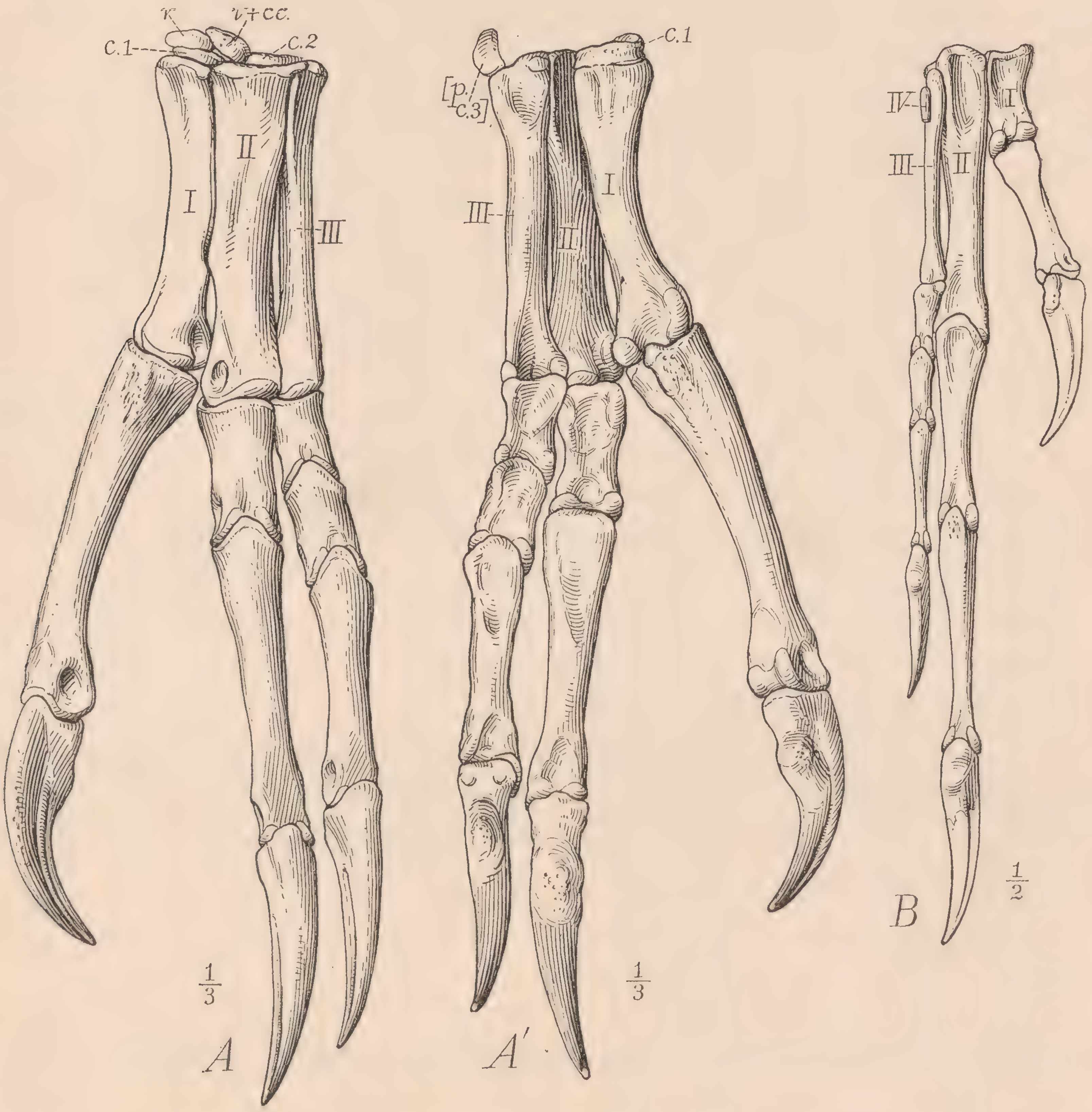

Fig. 3. Composition of complete manus (B) palmar view of *Ornitholestes hermanni.* Amer. Mus. 587, partly restored (Digit I) from Amer. Mus. 619, type. One half natural size.

Manus of *Struthiomimus altus,* Amer. Mus. 5339. (A), dorsal aspect; A′, palmar aspect. *r,* radiale, *i,* intermedium (?) coalesced with *ce,* centrale. *C*1, *C*2, p. *C*3 carpalia and (?) *p.* tendinous ossicle. One third natural size.

Fore limb. In the fore limb of *Ornitholestes* the humerus is somewhat longer (.127 m.) than the ulno-radius, which is also the proportion observed in *Struthiomimus.* In the figures accompanying the original description of *O. hermanni* (Amer. Mus. 587, see Figs. 7A, 7B, p. 748) the proportions are correctly represented.

We observe a marked anisodactyly and lateral compression of the manus (Figs. 2, 3 B). Mtc. II is enlarged and greatly elongate while Mtc. III is reduced and abbreviated, and Mtc. IV is vestigial; Digit I is partly known in the type as being short and somewhat divergent (Plate XXVI); Mtc. I and Ph. I. 2 only are preserved. This manus may, therefore, be described as functionally *anisotetradactyl* whereas that of *Struthiomimus* is comparatively *isotridactyl,* indicating a very marked difference in habit. In other words, the manus of *Ornitholestes* while subraptorial is more highly reduced than that of *Struthiomimus.* The central digits are closely appressed to each other (as in *Struthiomimus*) while the claws are relatively more powerful and recurved (Fig. 7B) than in *Struthiomimus.* The *Ornitholestes* manus is losing its fitness as a raptorial grasping type, it is too feeble and too much reduced; it represents a species adaptation to another purpose, recalling in some features the slender and greatly elongated digits of the Aye-Aye (*Cheiromys*). In (Fig. 3) *Ornitholestes, Struthiomimus,* and the manus associated with *Ornithomimus* (Fig. 3*a*) metatarsal I is closely appressed to metatarsal II. The phalanges of the pollex are divergent and rotated inwards in the two genera first named, *Ornitholestes* and *Struthiomimus.*

The fact that the central digits of *Ornitholestes* are closely appressed and incapable of spreading laterally harmonizes with the incipient coalescence of Mtc. I and Mtc. II in *Struthiomimus.* Another harmony is the divergence of the phalanges of Digit I.

STUDY OF STRUTHIOMIMUS AND ORNITHOMIMUS.

TYPE LOCALITIES OF STRUTHIOMIMUS, ORNITHOMIMUS, AND TRICERATOPS.

The known Ornithomimidæ belong to two phases of Upper Cretaceous age which are widely separated in geologic time, as follows:

1. *Ornithomimus velox.* The genotype specimen of *Ornithomimus velox* Marsh is probably of Triceratops zone age. It consists of leg bones found in 1892 by G. L. Cannon about twelve miles from Denver, Colorado, near where the old Morrison should have left the mesa going down into Beaver Creek Valley at the head of a small arroyo east of road and near a small

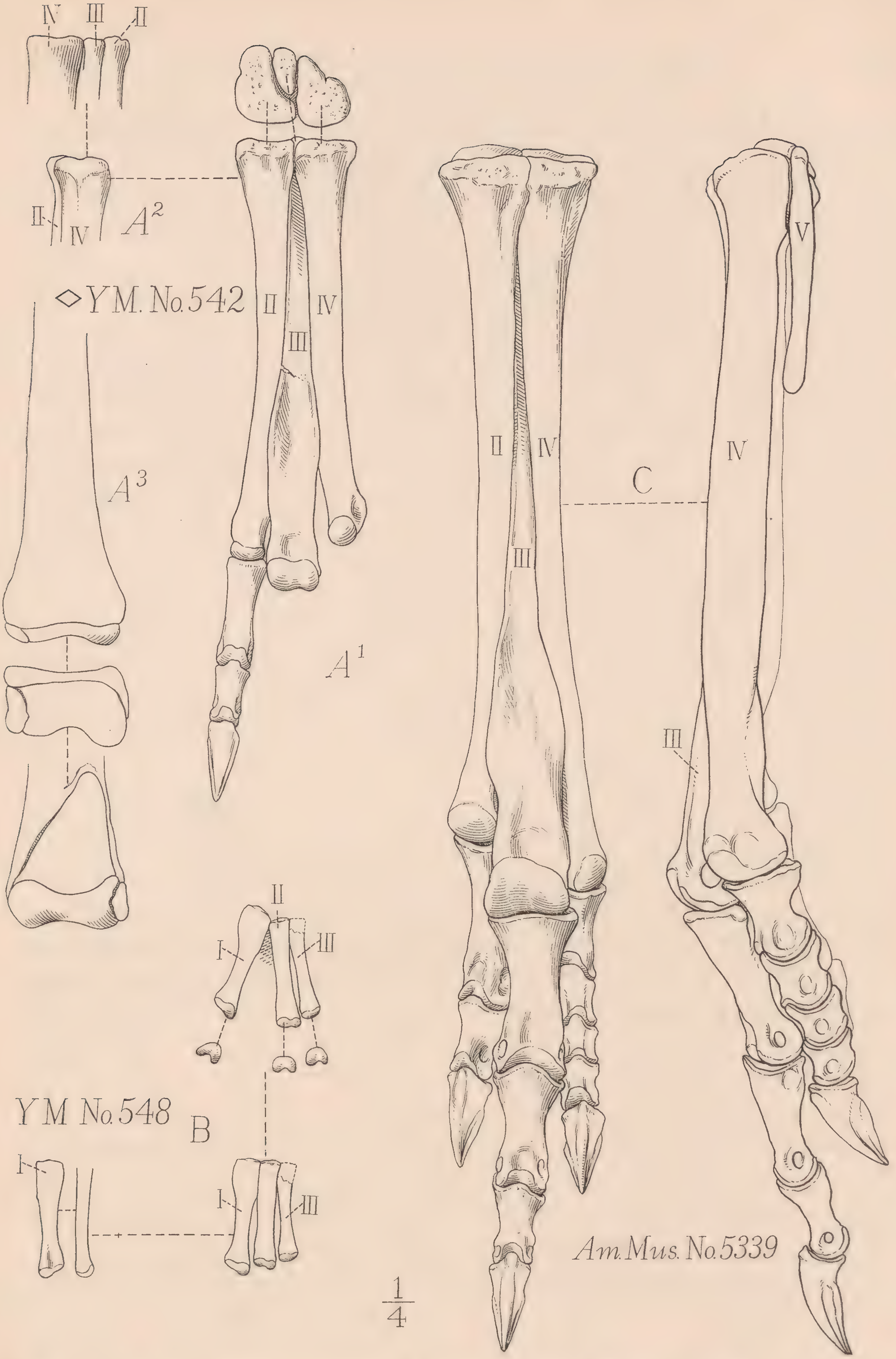

Fig. 3*a*. (A¹–A³). Genotype specimen of *Ornithomimus velox* Marsh. Yale Mus. 542. (A¹), dorsal aspect of the type left pes, superior aspect of Metatarsals II–IV. (A²) posterior aspect (upper) and exterior aspect (lower) of metatarsals II–IV. (A³) Type tibio-tarsus, anterior, inferior, posterior aspects. (B) Portion of right manus of another individual (Yale. Mus. 548) associated by Marsh with *Ornithomimus velox;* (upper) metacarpals I–III as they appear in the matrix, (lower) as placed in natural position. (C) Left pes of *Struthiomimus altus*, genotype specimen, Amer. Mus. 5339. Anterior and exterior aspects of digits II–V. One fourth natural size. After original drawings by the present author. One-fourth natural size.

white school house.[1] The geologic age of this genotype still remains to be determined precisely; it is probably the Triceratops zone. The records of the Peabody Museum, Yale University, are as follows: The genotype of *Ornithomimus velox* bears the catalogue number Yale Museum 542, collected by George L. Cannon June 30, 1889, in the Denver sandstone, in the southwest quarter of section 27, tier 4 S., range 69 W. The locality note in Professor Marsh's handwriting is as follows: "Foot of *Ornithomimus* ? found on Bear Creek road from Morrison to Denver, where it leaves the creek and goes on hills, 6 m. from Morrison. (Right hand side road). 20 ft. from road bed, near end of gully within 100 yards of house of left of road (white house with chicken coops and the only house on slope of hill near top.) 6 ft. below road bed and near end of gully." The presumption is that this is the same horizon as that of *Triceratops* (*Bison*) *alticornis*, but that specimen is now in the United States National Museum, Washington.[2] The locality of the type of *Triceratops* (*Bison*) *alticornis* is in the suburbs of the city of Denver. The records of the United States National Museum give the locality of the type of *Triceratops alticornis* as Green Mountain Creek, near Denver, Colorado.[3] Marsh in his description says: "Portions of the same specimen were subsequently secured by Whitman Cross of the U. S. Geological Survey."

2. *Struthiomimus tenuis.* The type of the geologically more ancient "*Ornithomimus*" *tenuis*[4] Marsh bears the catalogue number U. S. Nat. Mus. 5814. It is of Monoclonius-Ceratops zone age, from the Judith River formation as exposed on Birch Creek, Montana, and was collected by J. B. Hatcher in 1888. Hatcher states[5] that he found Marsh's type of this species, consisting of a foot and a portion of a limb, on Cow Island, Missouri River, at a level which he estimates from 1,500 to 1,600 feet below the summit of the Judith River beds and 500 to 600 feet below the level of Marsh's type of *Ceratops montanus.*

3. "*Ornithomimus*" *grandis.* The type of "*Ornithomimus*" *grandis* Marsh has not been located in the United States National Museum; its generic and family reference is therefore doubtful at present. It may belong to the genus *Deinodon* Leidy. Hatcher's record regarding its geological position (Bull. U. S. Geol. Surv. 257, pp. 12–41–87) is that it was found in the Eagle Sandstones.[6]

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[1] Notes given for the writer by G. L. Cannon to Mr. Barnum Brown orally on June 29, 1916.

[2] Letter of R. S. Lull to the writer, January 12, 1916.

[3] Gilmore, Charles W. Letter to the author, January 15, 1916.

[4] If the genus *Struthiomimus* is established this species should be transferred to it.

[5] Hatcher, J. B. *Science*, N. S., Vol. XVI., no. 412, November 21, 1902, pp. 831–832.

[6] Gilmore, Charles W. Letter to the writer, Jan. 15, 1916.

	Ceratops-Monoclonius Zone		Anchiceratops-Leptoceratops Zone	Typical Triceratops alticornis zone	Triceratops-Torosaurus zone
	Judith River Formation Montana	Belly River Formation Alberta	Edmonton Formation Alberta	Denver Basin Colo.	Hell Creek Montana
1. *Ornithomimus velox* Marsh, genotype				×	
? *Ornithomimus velox* ?sp., Amer. Mus. Nos. 5016, 974, 975, 1006, 5003, 5014, 5015, 5018, 5019, 5051, 5884, 5891, ?5017, ?5050					××××××× ×××××××
? *Ornithomimus velox* ?sp., Amer. Mus. Nos. 5201, 5255, 5257, 5262, 5264			×××××		
2. "*Ornithomimus*" (= *Struthiomimus*) *tenuis* Marsh, type	×				
3. "*Ornithomimus*" (= ? *Deinodon*) *grandis* Marsh, type	×				
"*Ornithomimus*" (= *Struthiomimus*) *altus* Lambe, type		×			
4. *Struthiomimus altus,* genotype, Amer. Mus. Nos. 5339, 5355		××			

The American Museum expeditions have secured abundant remains of the Ornithomimidæ in three zones, viz.: Belly River (= Fort Pierre), Edmonton (= intermediate), Hell Creek (= Lance).

4. *Struthiomimus altus.* The type of *Struthiomimus* (*Ornithomimus*) *altus* Lambe is from the Belly River series, Red Deer River, Alberta, Canada, now regarded as of approximately the same age as the Judith River. It consists of a "complete right hind limb (including the foot), the phalanges of the left foot in place, a pubic bone, and an ischium, of one individual" (p. 50).[1] Catalogue number 930f Ottawa Museum. "The right hind limb with the phalanges of the left foot, were found in 1901, below Berry Creek." (p. 53).

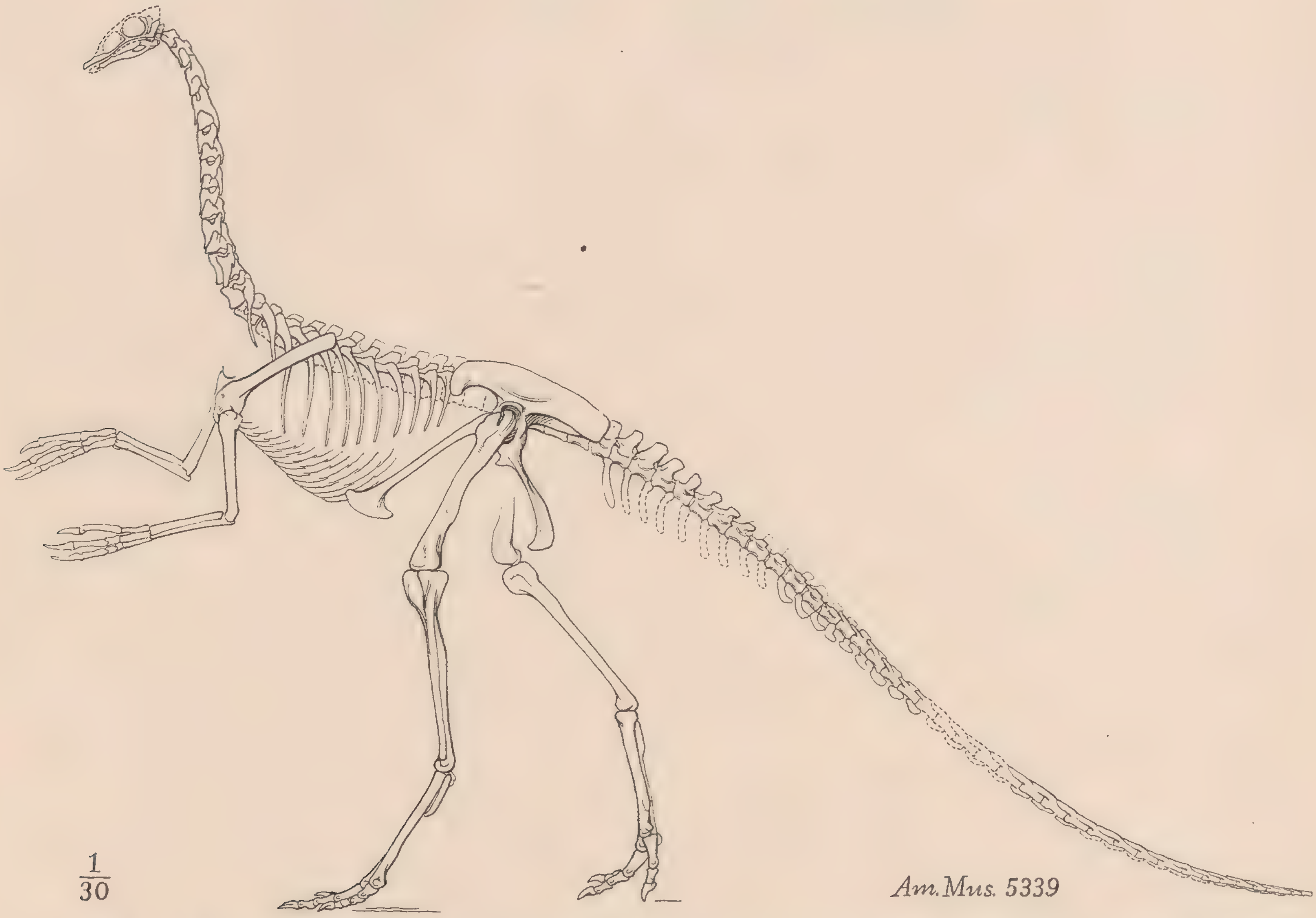

Fig. 4. First restoration of the skeleton of *Struthiomimus altus*, Amer. Mus. 5339. Digit I is set too close to digits II, III. One-thirtieth natural size.

MATERIALS IN THE AMERICAN MUSEUM.

Year after year the trying search for Ornithomimidæ remains has been encouraged by the author.

The American Museum expeditions under the leadership of Barnum Brown, aided by Peter Kaisen, have resulted in securing fourteen specimens of Ornithomimidæ from the Triceratops zone of Hell Creek, Montana, the very close of the Cretaceous, five specimens from the intermediate Edmonton formation of Alberta, also a number of specimens from the ancient Belly River formation of Alberta, including especially the nearly complete skeleton, American Museum No. 5339, which forms the basis of the present description and affords the first complete knowledge and restoration of the animal. As bearing on the habits of these animals it is noteworthy that the geologic occurrence is invariably in shore deposits, with remains of molluscs, ripple marks, and plant life, indicating littoral conditions and affording ground for the association of these animals with shore feeding habits.

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[1] Osborn, H. F., and Lambe, Lawrence M. "On Vertebrata of the Mid-Cretaceous of the North West Territory." Geol. Surv. of Canada, Contributions to Canadian Palæontology, Vol. III, Pt. II, pp. 7–81, 24 text figs., 21 pls.

The specific reference of this skeleton of the Belly River series is probably to the species *Struthiomimus* (*Ornithomimus*) *altus* Lambe, the comparative measurements being as follows:

	Type of *Struthiomimus* (*Ornithomimus*) *altus* Lambe 930f Ottawa Museum	*Struthiomimus altus.* Complete skeleton Amer. Mus. 5339
Length of femur	.430	.480
“ “ tibia (from 2 specimens)	.560e	.540
Antero-posterior diameter of shaft of femur at mid-length	.045	.044e
Transverse diameter of same tibia above distal end	.041	.041
Length of Mts. IV	.335	.370
“ “ “ V (non-functional)	.100	.119
“ “ Digit II	.164	.150
“ “ “ III	.213	.210
“ “ “ IV	.143	.150

It is noteworthy that only a single genus or species of dinosaur is known to pass from the Monoclonius-Ceratops zone into the Triceratops-Torosaurus zone; this is the genus *Trachodon.* The known carnivorous and herbivorous dinosaurs underwent profound modifications, and it is not probable, therefore, that the Ornithomimidæ remained generically unchanged. This specimen of the Ornithomimidæ comes from a much older geologic horizon than that of the genotype of *Ornithomimus,* which is from the Triceratops zone; it belongs to a distinct genus, or subgenus for which the name *Struthiomimus,* ‘Ostrich mimic,’ is proposed in reference to its mimicry of the ostrich (*Struthio*) in the skull, neck, and foot structure.

Ornithomimus, as a geologically more recent stage, is distinguished by the loss of Metatarsal V in the pes (Fig. 3*a*) for which no facet remains (Fig. 3*a* A^2), and other characters. It was rightly defined by Marsh as possessing only three metatarsals. The geologically more ancient *Struthiomimus* retains a splint of metatarsal V.

Struthiomimus gen. nov.

Generic characters of Struthiomimus. Stage of evolution of the Ornithomimidæ, corresponding with the Judith River or Belly River formation, Monoclonius-Ceratops zone. Skull relatively small, edentulous; manus isotridactyl, with elongate and slightly recurved terminal phalanges, metacarpals I–II incipiently coalescent; pollex phalanges separate, divergent; pes anisotetradactyl, Mts. II, III, IV incipiently coalescent, Mts. V present, reduced; Digit III relatively elongated.

The generic characters are based upon the complete skeleton of *Struthiomimus altus,* Amer. Mus. 5339.

DESCRIPTION OF SKELETON OF STRUTHIOMIMUS ALTUS.

Text-figs. 2, 3, 4, 5, 6, 7, 8, 9, Plates XXIV, XXVI.

Proportions. In comparing this skeleton with that of *Ornitholestes* (Plate XXVI) we are immediately impressed with the extremely small size of the skull, elongation of the neck, abbreviation of the back, relative elongation of the tibia and of the tarso-metatarsus. These are the struthious analogies.

	mm.
Vertebral column, total length of	4.085
Pre-acetabular vertebræ, total length of	1.56
Post-acetabular vertebræ, “ “ “	2.525
Caudals, total length of	2.31

Non-struthious is the balancing power of the tail. The vertebræ behind the acetabulum exceed those in front of it by nearly a meter, and the posterior half of the tail is very stiff and rod-like and was thus doubtless used as a balancing organ in rapid cursorial motion.

As compared with *Ornitholestes* the fore limb is of the same relative length, but the manus is a very strong and fully functional organ.

Table of Measurements of Struthiomimus altus, Amer. Mus. 5339.

	mm.
Skull, length of, tip of premaxillary to back of quadrate	.240
“ lower length, tip of dentary to back of articular	.215e
Cervical vertebræ, series of 10 inclusive	.770
Thoracic “ “ “ 13 “	.760e
Sacral “ “ “ 5e “	.230e
Caudal “ “ “ 39 “	2.31e

	mm.
Fore limb, total length	.850
Scapulo-coracoid, total length	.445
Scapula “ “	.335
Humerus “ “	.310
Ulno-radius “ “	.230
Manus, including phalanges, approximate length	.315e
Digit I: Mtc. I “	.085
Pollex I.1 “	.110
Pollex I.2 “	.065
Digit II: Mtc. II “	.100
Phalanx II.1 “	.040
“ II.2 “	.090
“ II.3 “	.085
Digit III: Mtc. III “	.095
Phalanx III.1 “	.025
“ III.2 “	.035
“ III.3 “	.075
“ III.4 “	.080
Pelvic girdle: ilium, length of	.450
pubis “ “	.475
ischium “ “	.335
Hind limb, total length including femur to tips of phalanges	1.530
femur, length of, extreme measurement	.480
tibia, “ “	.540
Mts. III, “ “	.370

Proportional Measurements, Indices, and Ratios.

Fore limb, brachium, total length humerus to tip of phalanges	.850
Hind limb, crus, “ “ “ “ “ “ “	1.530
Brachio-crural ratio (proportion of fore to hind limb)	55%
Femoro-tibial ratio (proportion of femur to tibia)	88%

Skull. The unique feature of the skull is the total absence of teeth and indications that the premaxillaries and dentaries were sheathed in narrow horny beaks somewhat similar to those of *Struthio*. The skull as a whole (Fig. 5A, B) is only one-third longer than that of *Struthio* although it is attached to a vertebral column over thirteen feet in length. The dentary is relatively deeper and more powerful than that of *Struthio* and apparently closes on the inner side of the premaxillaries. All the areas of muscular attachment are very slight as compared with those of the carnivorous dinosaurs. The muscles of the jaws are relatively feeble as compared with those of the carnivorous dinosaurs but more powerful than in *Struthio*.

The relations of the dentary, surangular, angular, articular, lachrymal, jugal, quadrate are totally different from those of *Struthio* and indicate direct derivation from the theropod dinosaur type. The chief distinctions from the cranium of *Allosaurus* and *Tyrannosaurus* (Osborn, 1912, p. 28, figs. 25, 26[1]) are: (1) the great size of the orbit, which is relatively as large as in *Struthio;* (2) the constriction of the post-temporal fossa; (3) the vertical elongation of the quadrate-quadrato-jugal; and (4) the anterior inclination of the lower end of the quadrate as distinguished from the backward inclination of the same element in *Allosaurus*. The cranium thus presents a very wide contrast to that of *Allosaurus* and the widest possible contrast to that of *Tyrannosaurus,* indicating a profound change of function.

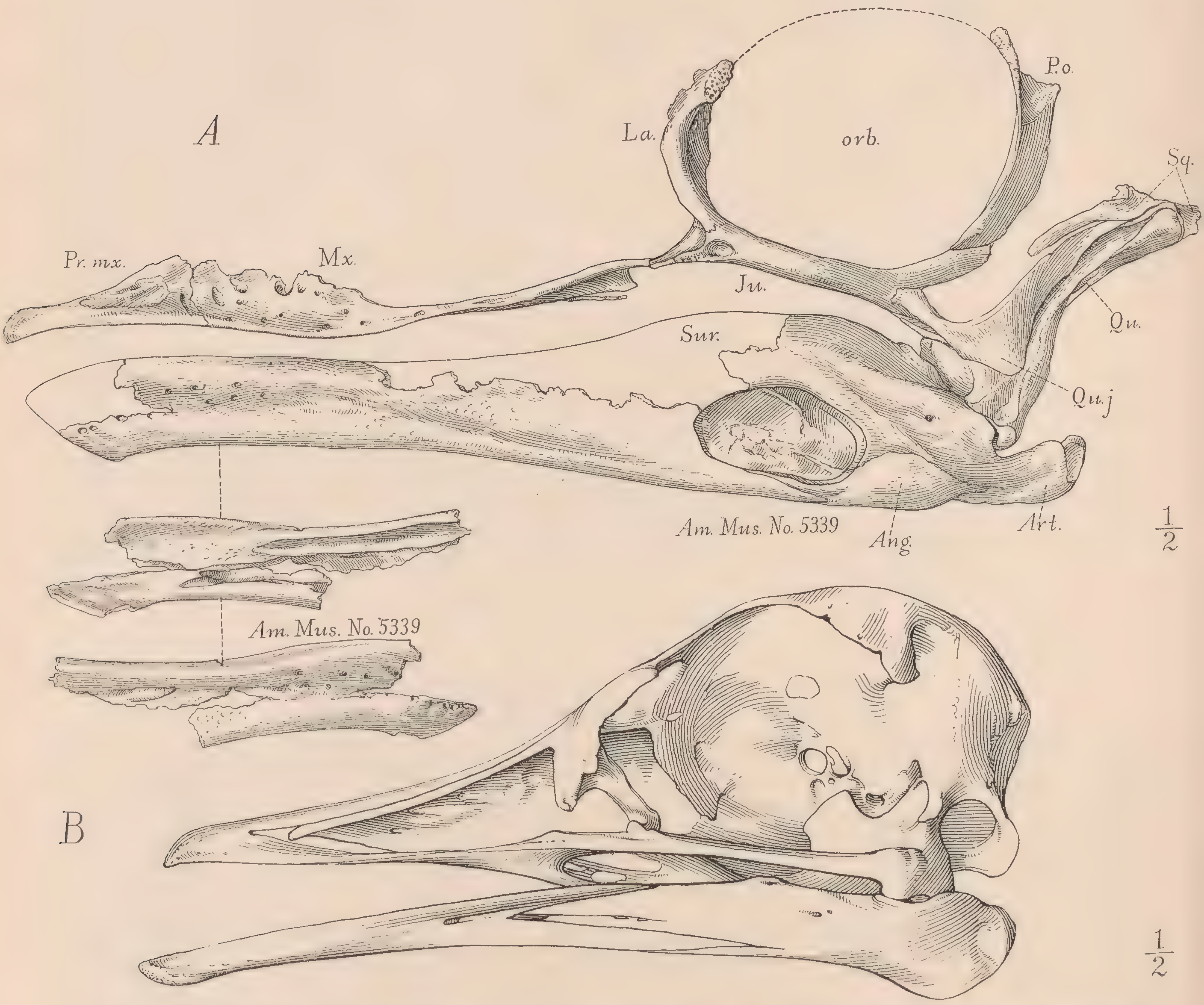

Fig. 5. Skulls of *Struthiomimus* and *Struthio* compared. A Portions of the skull and jaws of *Struthiomimus altus*, Amer. Mus. 5339, showing the left dentary, also the outer and inner aspect of the right dentary. B Skull of *Struthio*. Both figures one-half natural size.

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[1] "Crania of Tyrannosaurus and Allosaurus." Mem. Amer. Mus. Nat. Hist., N. S., Vol. I, Pt. i, June, 1912, pp. 1–30, pls. i–iv, figs. 1–27.

Cervicals. The cervical centra are uniformly elongate and the cervical ribs, instead of being loosely attached as in *Ornitholestes* and in the typical Theropoda, are abbreviated and closely coalesced to the sides of the centrum and neural arch in C 3–10. Cervicals 6–11 are amphicœlous. C 12 is procœlous. C 4 is slightly procœlous. C 3 is opisthocœlous. This is an indication of a long, flexible, and powerful neck, as in *Struthio.*

Thoracics. The thoracic or dorsal vertebræ, T 1–13, are distinguished by elongate bicipital ribs, the anterior pair of which (T 1–T 2) are freely movable, while in T 3–T 10 the thoracic ribs are connected below with the sternal rib elements. In T 12 and T 13 the ribs are not observable in this specimen, but were probably attached to the inner side of the anterior crest of the ilium. The centra of T 1–3 are preserved and seem to be gently opisthocœlous; from T 4–13 the centra are not observable; the neural spines indicate progressive increase in size and abbreviation in length.

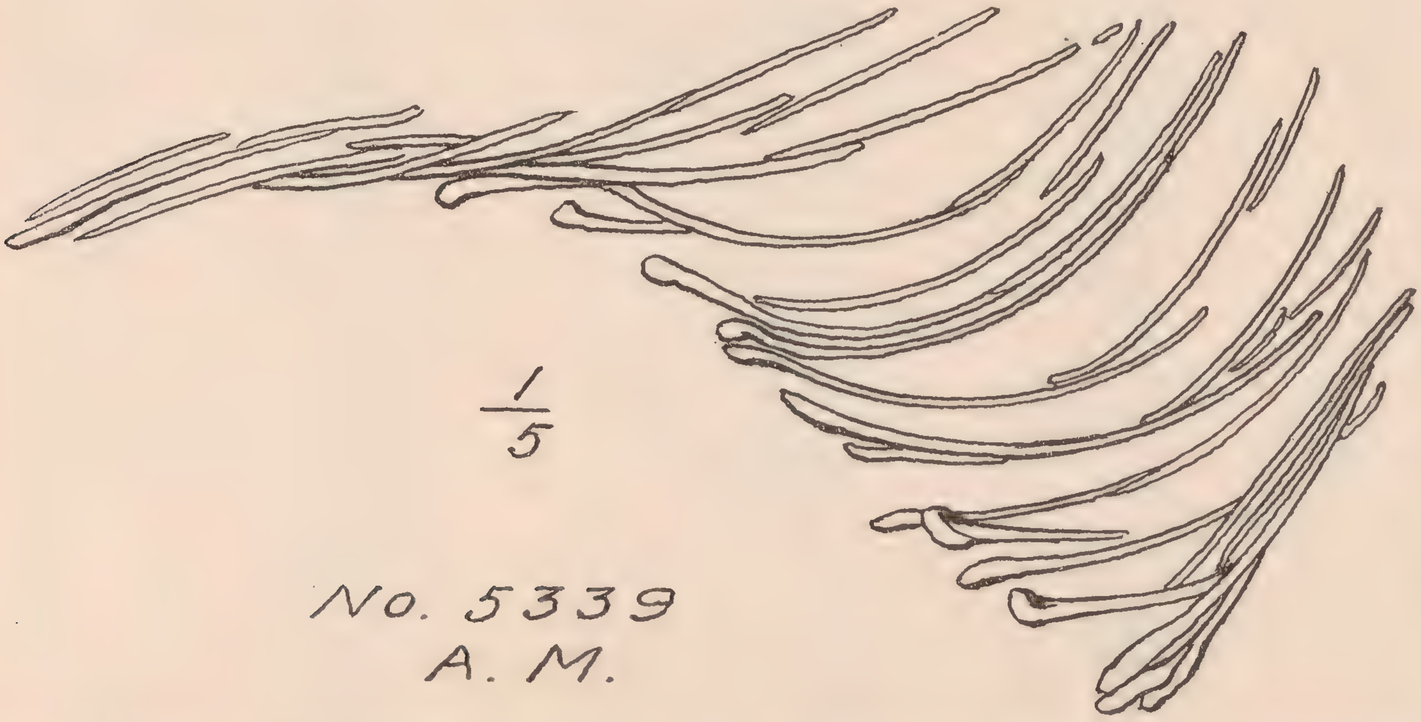

Fig. 6. Detail of the actual arrangement of the abdominal ribs in *Struthiomimus altus*, Amer. Mus. 5339, as preserved on the left side of the thorax. One-fifth natural size.

Sacrals. The sacral centra cannot be clearly distinguished; the indications are that there were five sacrals closely coalesced. S 3–?5 are visible behind the acetabulum (compare *Tyrannosaurus,* Plate XXVII). The supposed S 5 is coalesced laterally with the postero-internal plate of the ilium. Superiorly the sacral spines unite in a continuous single, closely compressed plate, wedged in between the iliac borders (compare *Tyrannosaurus,* Fig. 17).

Caudals. Seventeen caudals are preserved in continuous series in this specimen, Amer. Mus. 5339, the typical theropod characters of which are clearly shown in Plate XXVI. Then follows an unknown interval in which five vertebræ have been inserted, behind which fifteen vertebræ are added from the specimens American Mus. Nos. 5355, 5262. These vertebræ, C 12–C 26, C 30, exhibit the remarkable rod-like elongation of the prezygapophyses, so that the apex overlaps the base of the prezygapophysis in front. The postzygapophyses are greatly reduced. The chevrons are elongate and rod-like also.

Sternal ribs. These elements consist of at least thirteen rows (corresponding with the thirteen thoracic ribs) each including a triple series on each side as represented in Fig. 6 and Plate XXVI, namely: (1) a short, very slender *proximal* series; (2) a slender *median* series about twice the length of the proximal; (3) a stouter *ventral* series, of about three times the length of the proximal, which terminate in club-shaped expansions in the median line. The sternal rib apparatus as a whole is exceedingly delicate and indicates a feeble development of the pectoral muscles.

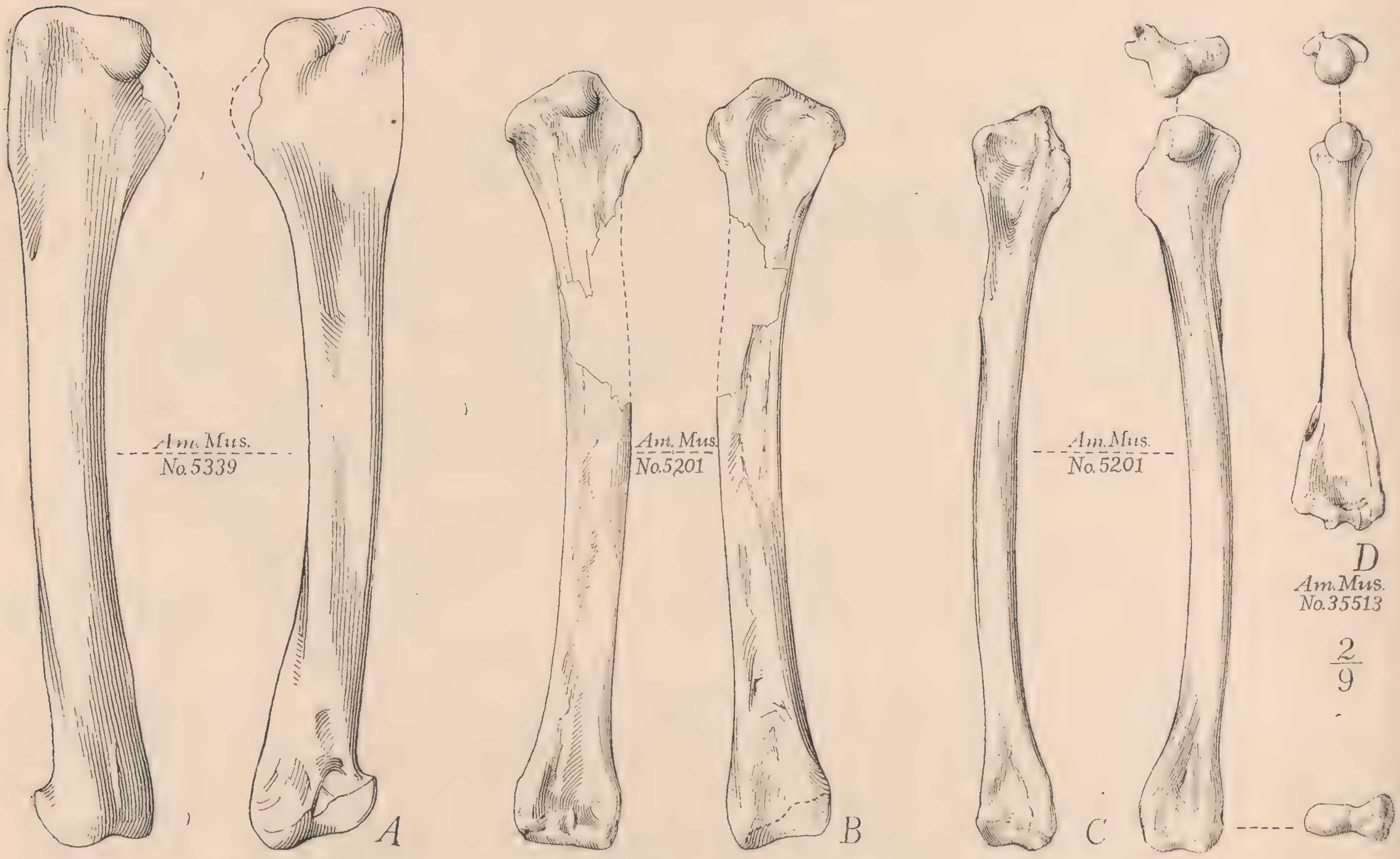

Fig. 7. Humerus of *Struthiomimus altus* and of *Cholœpus didactylus* compared.
A Crushed left humerus of *S. altus*, Amer. Mus. 5339. B Normal left humerus of *S. altus*, Amer. Mus. 5201. C Right humerus, anterior and posterior views of *S. altus*, Amer. Mus. 5201. D Right humerus of two-toed sloth, *Cholœpus didactylus*, Amer. Mus. 35513, posterior view. All figures two-ninths natural size.

Fore limb. Figs. 3 A, 8. The scapula is slender and firmly coalesced with the coracoid. The humerus (Fig. 7) is relatively slender as observed in two specimens (Amer. Mus. Nos. 5339, 5201). The small, backwardly directed head (Fig. 7 C) is supported by the lesser and greater tuberosities, which are somewhat more strongly developed than in the arboreal two-toed sloth, *Cholœpus didactylus* (Fig. 7 D). The shaft is relatively longer and

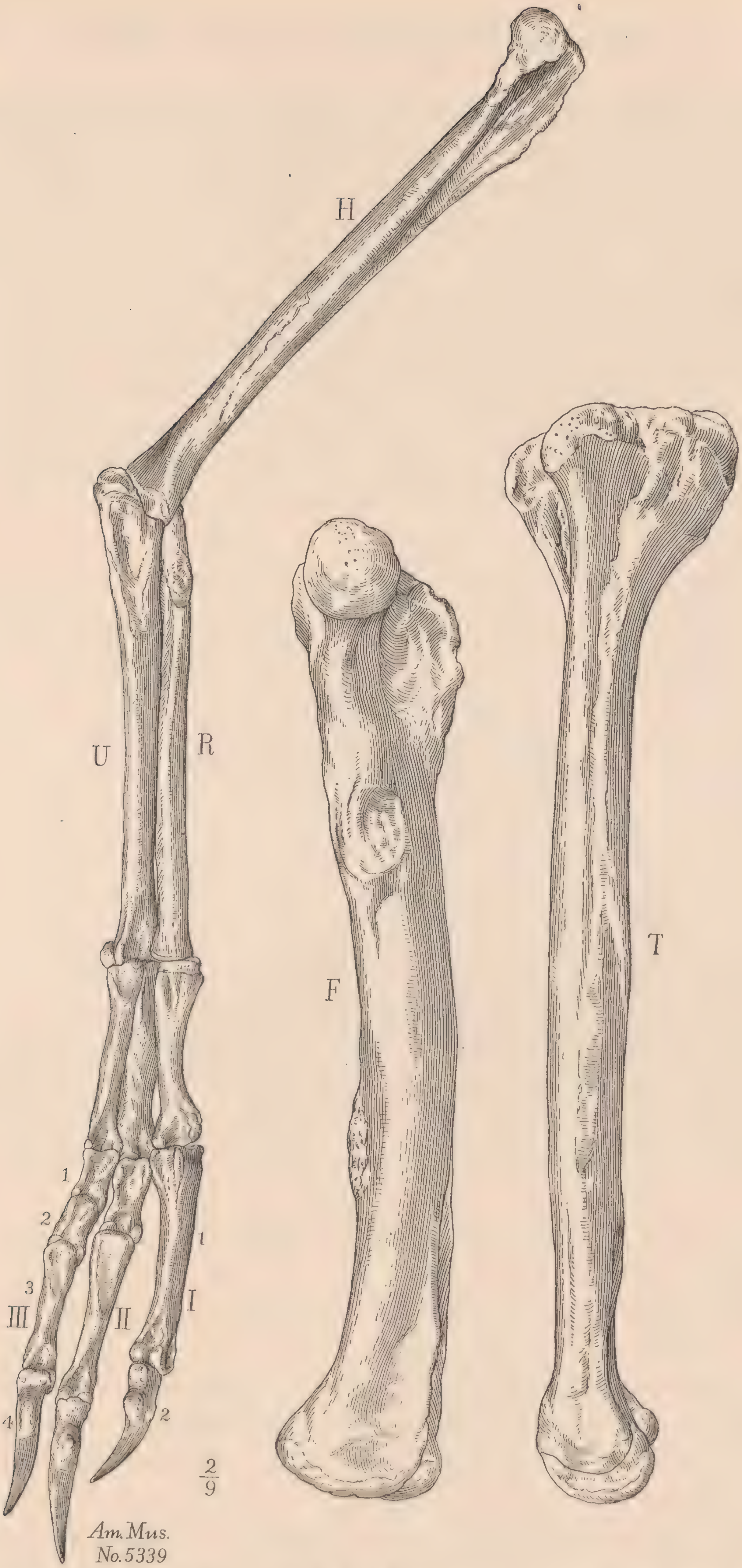

Fig. 8. Fore and Hind limb bones, H, U, R, of *Struthiomimus altus*, Amer. Mus. 5339, to same scale. Palmar aspect of left fore limb. F Left femur, internal aspect. T Left tibio-tarsus, internal aspect. All figures two-ninths natural size. Manus more correctly drawn in Fig. 3.

more slender than in *Cholœpus* and the distal extremity is relatively narrower and has less provision for muscular attachment than in *Cholœpus*. The absence of muscular attachments on the pronator and supinator condyles of the humerus as well as the generally slender structure of this bone forbid the assumption of fossorial function for this peculiar limb. The ulna and radius are attached somewhat obliquely to the perpendicular axis of the shaft. A small sesamoid or vestigial Mtc. IV appears at the junction of the ulna and Mtc. III. The carpal series is represented by five separate elements, Fig. 3 A; it includes the radiale, intermedium, ulnare, carpale 1 and carpale 2, much flattened. Mtc. I–III are short and equal in length, and Mtc. II–III are firmly fitted to each other; Mtc. I and Mtc. II exhibit an incipient coalescence; they are synmetacarpal but not syndactyl.

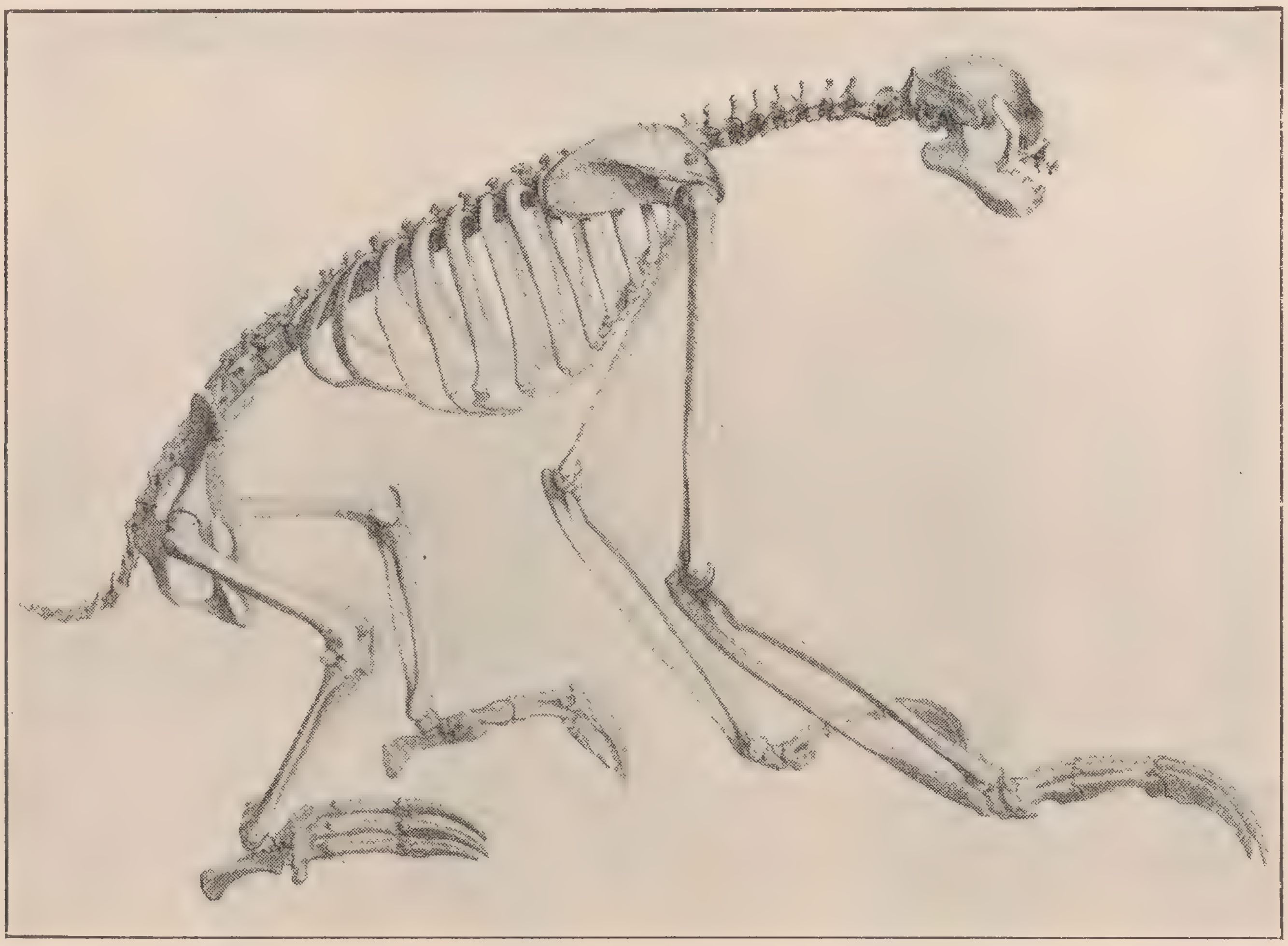

Fig. 9. Skeleton of the three-toed Sloth, *Bradypus tridactylus*. After De Blainville.

The phalanges of Digit I, the pollex, are separate and divergent from those of Digits II, III which tend to be appressed and syndactylous; there are indications of more or less rotation and opposition or grasping power in the pollex.

Manus. The very unequal elongation of the *phalanges* is a peculiar feature of the manus; especially the first phalanges of Mtc. I, II, III are of totally different lengths. This is compensated for by the elongation of phalanx D II.2 which is unusually long. These three digits, therefore, through the abbreviation of D III and the elongation of D I are approximately isotridactyl as in *Bradypus tridactylus* (Fig. 9). This arrangement is quite different from that of *Ornitholestes hermanni* (Fig. 3) in which D I is reduced but D II is very much more elongate than D III. The lateral motion of these phalanges is partly provided for in the joints between the metacarpals and the proximal phalanges. The remaining interphalangeal joints tend to confine the digits exclusively to an opening and closing movement as in many edentates or strict flexion and extension such as is also observed in *Ornitholestes* and in *Bradypus*. The distal phalanges are extremely long, slender, and slightly recurved, with strong attachments for the flexor perforans, less recurved, claw-like, or raptorial than those of *Ornitholestes* (Fig. 2). They are relatively longer and more slender than those of the greater or lesser anteaters and entirely lack the fossorial powers of the manus of these Myrmecophagidæ.

Hind limb. The hind limb (Fig. 8) is relatively robust, the femur (Fig. 8 F) having on a small scale the general form and areas of muscular attachment characteristic of the larger theropoda such as *Tyrannosaurus* (Fig. 18A[1]), with greater relative elongation. The tibio-tarsus (Fig. 10 T) is also a powerful bone, relatively more elongate than the femur. The fibula (Plate XXIV) is relatively slender.

The tarso-metatarsus, as previously described in *Ornithomimus* (Figs. 10, 11), consists of three closely coalesced median digits, D II–IV, in which Mts. III is thrust backward at the proximal end so that it only appears on the posterior face, while it is thrust forward at the distal end so that it makes up the greater part of the anterior face of the pes, in which D III is much the longest digit. Metatarsal V is greatly reduced, extending one-third down the shaft of Mts. IV.

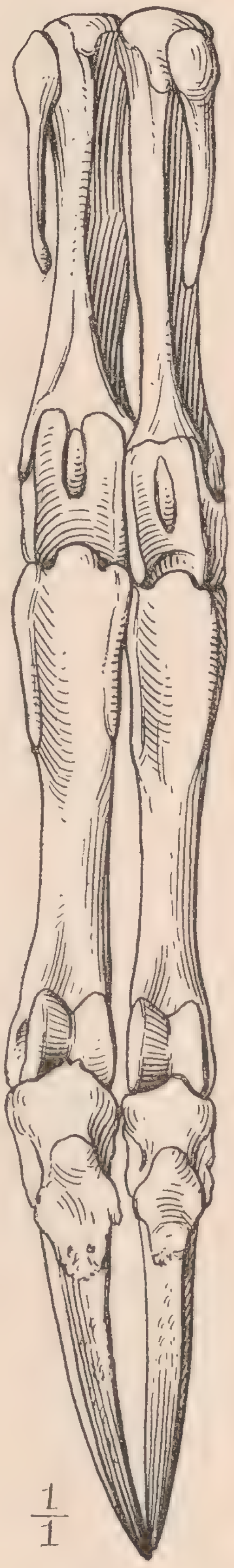

Fig. 10. Manus of two-toed Sloth, *Cholœpus didactylus*. Palmar aspect. Natural size.

The terminal phalanges are very slightly recurved, less elongate and pointed than in *Dinornis* among the struthious birds and slightly more pointed than in *Struthio*. This structure points to strictly cursorial rather than to raptorial function in the pes.

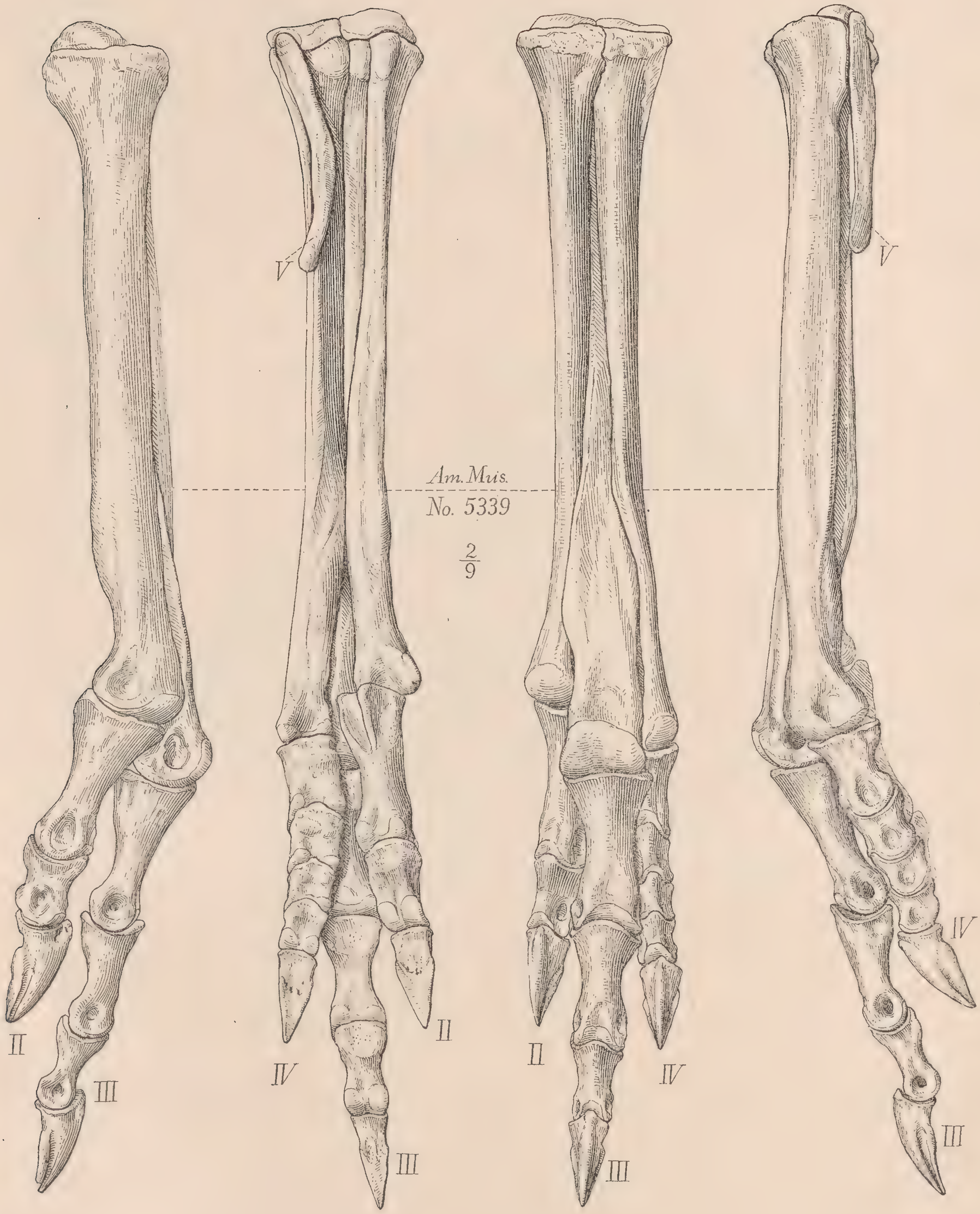

Fig. 11. Left pes of *Struthiomimus altus*, Amer. Mus. 5339. Internal, posterior, anterior, external aspects. Mts. II, III, IV, with three functional digits, Mts. V reduced. Two-ninths natural size. Compare Fig. 3*a*.

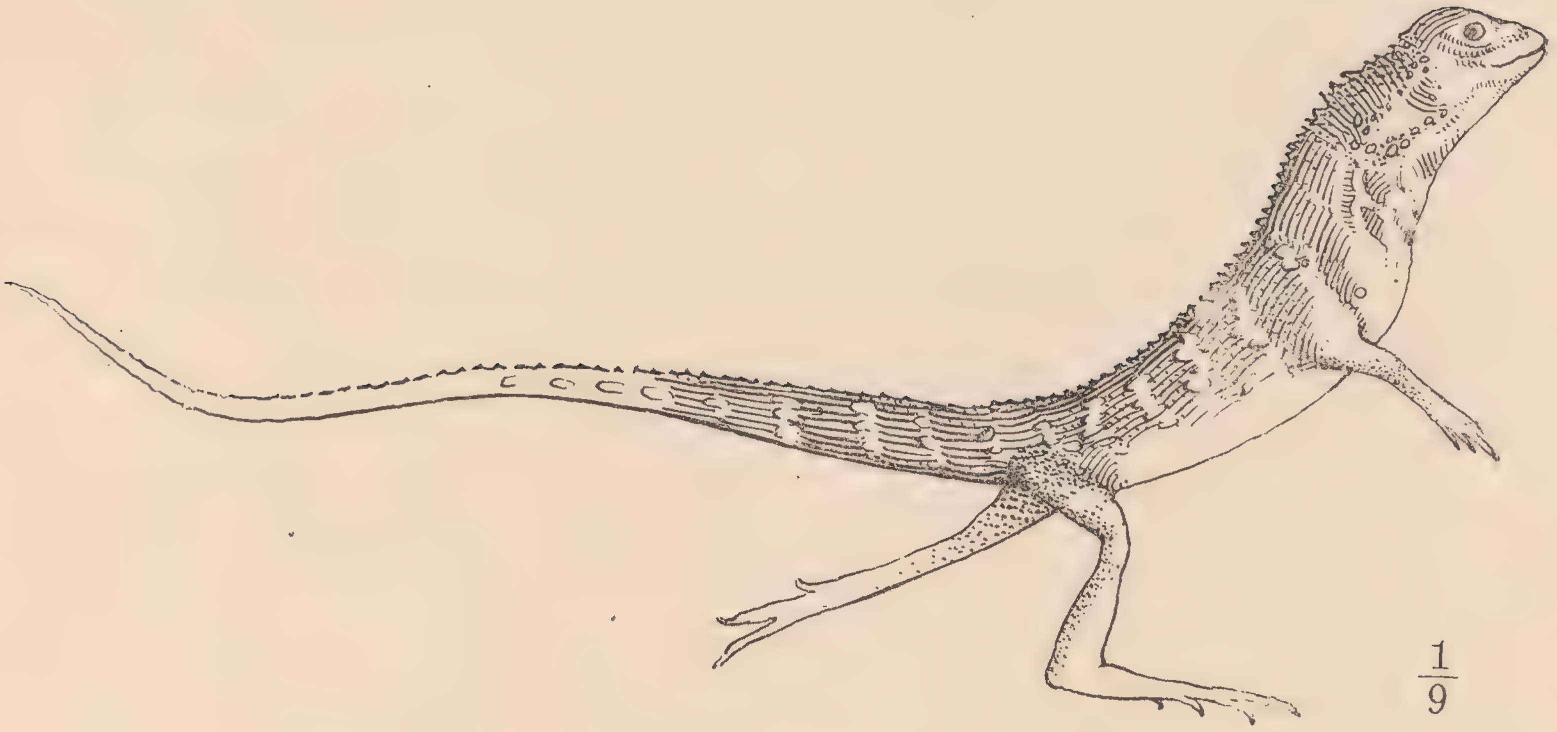

Fig. 12. Australian water lizard, "Lesueur's lizard" (*Physignathus lesueurii* Gray), Queensland variety, family Agamidæ, from instantaneous photograph of running pose.

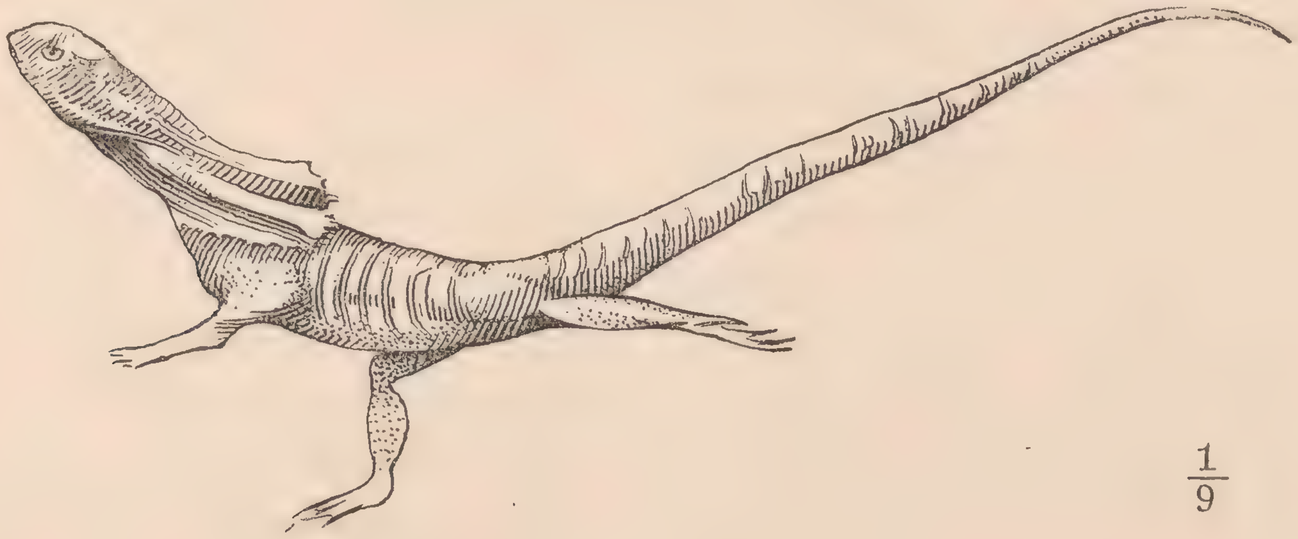

Fig. 13. Frilled lizard *Chlamydosaurus*, family Agamidæ. Instantaneous photograph of swift running pose. After Saville Kent.

Habits of Struthiomimus.

In view of the ostrich-like structure of the skull and of the pes, and the partly suspensory, partly grasping structure of the fore limb and manus of *Struthiomimus,* it is very difficult to form a consistent hypothesis of the habits of this remarkable animal. It may be compared with certain of the lizards, the struthious birds, the tree sloths (*Bradypus, Cholœpus*), and the Aye-Aye (*Cheiromys*).

Comparison with lizards.[1] The habit of lizards of running upon the hind legs (Figs. 10, 11) with the body reared upward has been observed among representatives of three families, namely, the Old World Agamidæ (Agamas), the New World Iguanidæ (Iguanas) and Teiidæ (Tegus, Race Runners). (1) The two first named families have a distinct affinity, arising either from parallelism of development among varied genera or from actual relationship as alleged by some writers. The systematic separation of the Agamidæ and the Iguanidæ is mainly by the dentition, which is acrodont in the former and pleurodont in the latter. The family Teiidæ is of remote relationship to both of the first named families. (2) Among the species of lizards observed at times to rear and use the hind legs only for locomotion are highly active types, large and small, that live under various conditions. The habit has been observed among large arboreal species as well as among lizards of diminutive size, several of the latter frequenting the deserts. (3) The lizard never rears, in fact, appears unable to do so, unless moving at a high rate of speed. The bipedal trait may be indicated immediately after the beginning of a dash over the ground, or the lizard may rear upward after it has run a considerable distance. In all cases the animal drops to all fours as its speed materially decreases. During the reared running pose the front legs appear to involuntarily droop forward and not to be used as balancers, but the position of the tail indicates the marked importance of this organ in balancing and a voluntary rearing or curving upward of the tail in order to keep the body upright. Mr. Ditmars has not observed the habit except in long-tailed species. (4) Lizards resorting to anthills are mostly burrowing and more or less limbless forms which present no analogy with *Struthiomimus*. (5) The grasping powers of the manus are developed in the tree-living chameleon, the fingers terminating in strong claws, two on each grasping knob, which should be compared with those of *Struthiomimus*.

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[1] Notes given to the author by Mr. Raymond L. Ditmars, Curator of Reptiles, N. Y. Zoölogical Park.

Running gait of Struthiomimus and Ornithomimus. From these studies of the lizards the running gait of *Struthiomimus* is suggested in the pose represented in Fig. 14A in which the rod-like tail balances the anterior half of the body. The estimated total length of the vertebral column being M 4.085, the length of the tail is estimated at M 2.525; thus the post-acetabular vertebræ are slightly longer than the pre-acetabular. The hind limbs are relatively longer than in any of the running lizards but relatively shorter than in the ostriches. It is noteworthy as compared with the running lizards that the ratio between the length of the fore and hind limbs is less in *Struthiomimus*. Its very awkward position in the supposed quadrupedal gait is shown in Fig. 14B.

Insectivorous theory of C. William Beebe. The ornithologist, C. William Beebe, has suggested that the feeble fore limbs of *Struthiomimus* may have been adequate for attacking sandy and gravelly anthills, as represented in Fig. 14B. There are three objections to this theory: first, the fore limb gives no evidence of any fossorial musculature; second, the beak affords no evidence of a protrusible tongue analogous to that of the Myrmecophagidæ; third, the terminal phalanges of the hind limb afford little evidence of power to scratch or dig but are rather of the cursorial type.

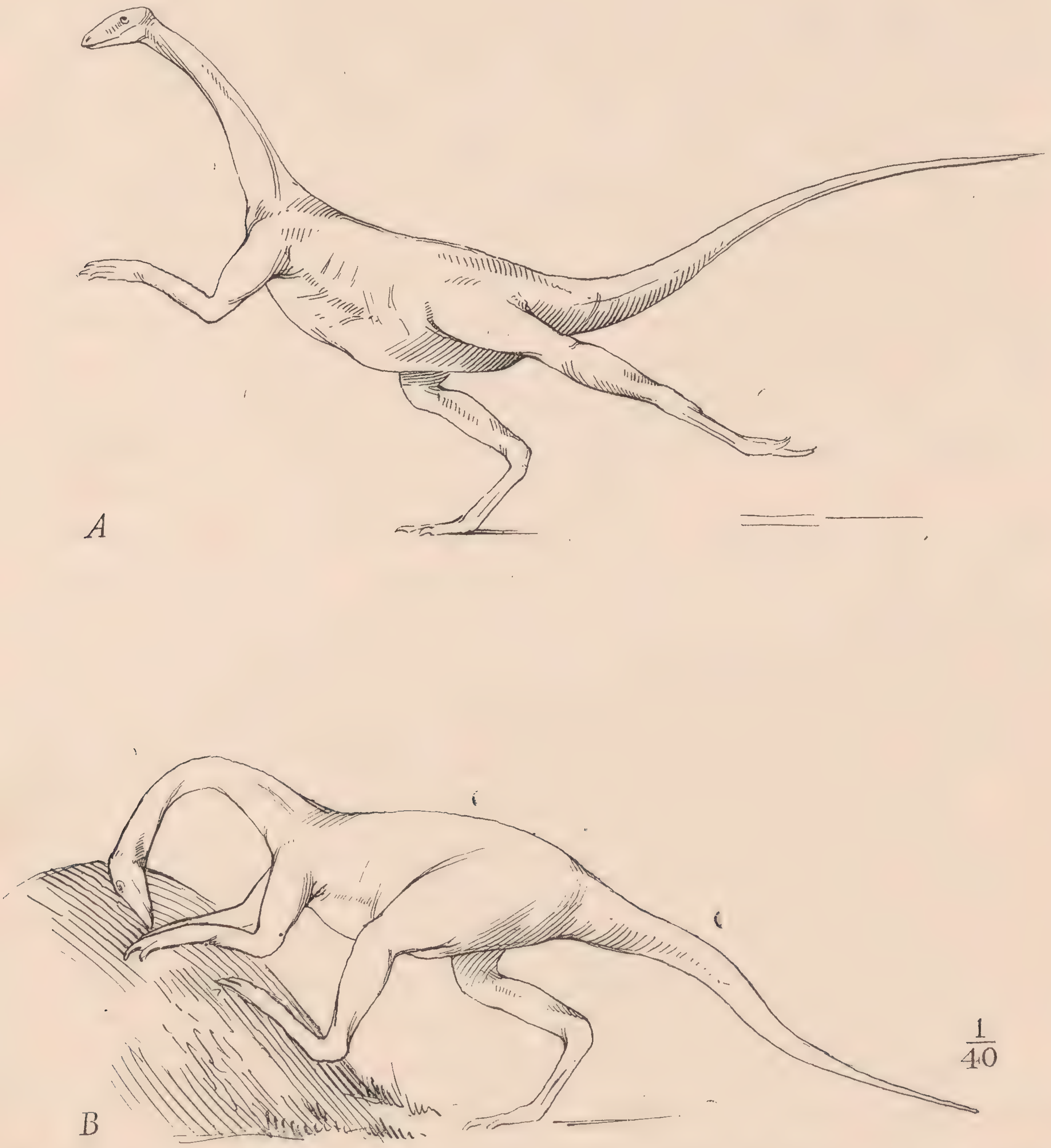

Fig. 14. Restorations of *Struthiomimus altus*, Amer. Mus. 5339. A Running pose suggested by Osborn. B Insectivorous theory, anthill-attacking pose suggested by C. William Beebe. One-fortieth natural size.

Sea-shore theory of Barnum Brown. Influenced by the fact noted above that the remains of *Struthiomimus* and *Ornithomimus* are invariably found in littoral deposits, Barnum Brown has suggested the theory that this animal waded along the shores, feeding upon small crustaceans and

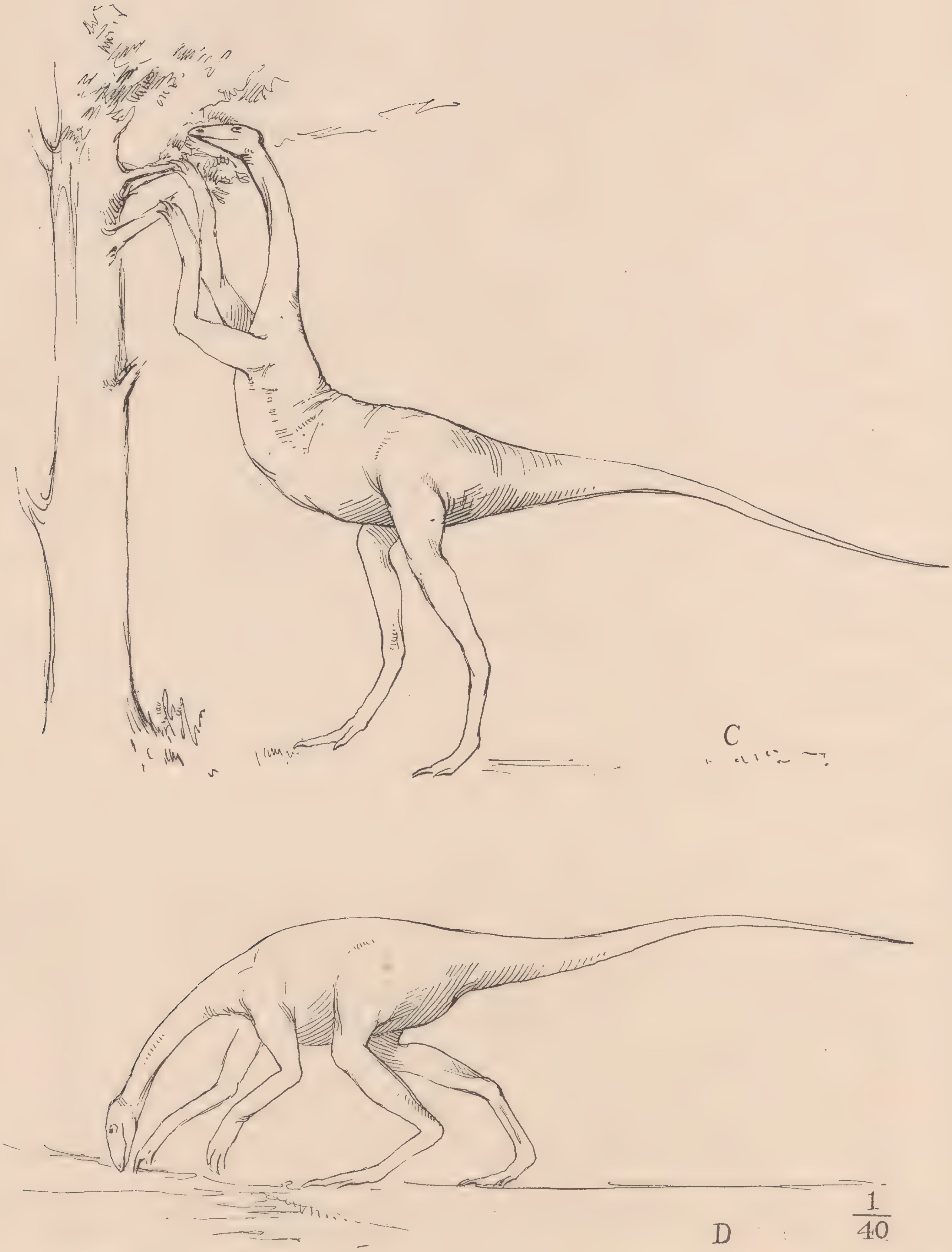

Fig. 15. Restorations of *Struthiomimus altus.* C Herbivorous, tree-browsing pose, suggested by Osborn. D Carnivorous, shore-living pose, hunting for Crustacea and small Mollusca, suggested by Barnum Brown. One-fortieth natural size.

molluscs, using its long anterior claws partly to scrape the sand and partly to seize these shore-living animals. The objections to this theory are three. First, neither the beak nor the terminal phalanges are adapted to seizing an actively moving crustacean prey of any kind although they may have been adapted to securing sessile Mollusca. Second, the feeble musculature of the forearm is non-fossorial, and non-raptorial; that is, it does not indicate powers of pronation and supination of the manus. Third, as pointed out by Beebe, neither the structure of the beak nor of the phalanges of the pes is analogous to that of the shore-living birds (grallatores) which partly live upon small invertebrates. Brown points out that while the attachments of the muscles are but slightly developed and the arm is of feeble power as a whole, the manus shows wonderful adaptability of finger movement, since while Mtc. II and Mtc. III are coalesced D I has an articulating face with Mtc. I which allows of a rotating movement and the opposition of D I to D II, III. The points noted are to Brown conclusive proof that this dinosaur in securing food depended chiefly on the movements of its neck and the prehensile power of the digits of the manus and that crustaceans were the favorite article of food, which the construction of the neck and manus were well adapted to capture.

Ostrich-like theory of Struthiomimus, Osborn. This theory, which seems the most probable one to the author, is depicted in Fig. 15C, namely, an herbivorous browsing pose in which the ostrich-like beak, sheathed in horn, is represented as securing leaves and buds while the fore limbs, two digits of which are analogous to those of *Bradypus tridactylus*, are used in supporting the fore part of the body and drawing down the smaller branches; the grasping power of the thumb, D I, may have facilitated this action.

First, in defence of this theory, a chiefly suspensory and limb-grasping function of the fore limb is indicated by its analogy to that of the tree sloth, *Bradypus tridactylus* (Fig. 9), the analogy consisting in the slenderness of the humerus and of the ulno-radius, the apparent slenderness and suspensory character of the muscles and especially the *isodactyly* of the manus, a highly distinctive feature of the tree sloths. Second, the bird-like and especially ostrich-like structure of the neck, which is totally unlike that of the carnivorous dinosaurs and very similar to that of the struthious birds especially, in which very rapid fore-and-aft motions of the head are observed during the act of browsing. Third, the bony structure of the upper and lower jaws indicates the possession of a horny beak similar in shape to that of the browsing birds especially of the struthious type. There is no curvature of the beak suggesting analogy to the carnivorous birds, nor broadening of the beak suggestive of that of the wading birds (grallatores). Fourth, it appears probable that the pes was purely cursorial, adapted to dry or hard earth, since its analogy to that of the various members of the ratite order, such as *Struthio, Rhea, Casuarius, Dinornis,* is very close. Such feet are used primarily in locomotion, secondarily for the scratching of sand for the burying of eggs, and thirdly as weapons of defense; they are not adapted for assisting the fore limb and the beak in the prehension of food.

Notes on the Habits of Struthiomimus by Dr. William K. Gregory. (1) "Were the forearms used in pulling food toward the mouth, either up from the ground or down from the trees? Probably yes. (2) Were the forearms used in climbing up low trees? Probably no. (3) Were the forearms provided with a small patagium, which could be used in swift flight on the ground? [Hypothetical.]"

"The long slender forearm of *Struthiomimus* had a long reach and great freedom of motion at the shoulder, as shown by the form of the head of the humerus. The elbows were undoubtedly everted, in reptilian fashion. While the radius could not be twisted around the ulna so that true supination was very limited, yet merely by moving the elbow in toward the body the palms of the opposite manus were turned toward each other (partly supinated), while by moving the elbows outward from the body the manus was brought into the position of pronation and the opposite manus brought together. The wrist joint was very stiff, capable of very little extension; the three metacarpals were closely appressed; there was considerable motion between the metacarpus and the proximal phalanges. In the third digit the second and third metacarpals were closely appressed and in the way of coalescence, but the distal phalanges of the second and third digits could be sharply flexed. By virtue of the twisting of the first metacarpal the phalanges of the first digit could be turned partly toward the other digits so that the manus was to a certain extent prehensile. The ungual phalanges were large and falcate, deeply grooved at the sides and evidently bore stout and sharp claws, larger than those of a grizzly bear. The deep pits at the sides of the distal ends of the penultimate phalanges testify to the great strength of the ligaments connecting the distal and penultimate phalanges, while the large size of the claw phalanges and their swollen proximo-inferior bases indicate a powerful development of the flexor profundus (perforans). The manus as a whole, as observed by Professor Osborn, partly suggests that of the tree sloths, not only in its general form, but in the tendency toward coalescence of two of the successive phalanges, and in the large size of the claws. It differs from the sloth type, however, in the lateral mobility of the first digit and of the proximal phalanges of all the digits."

"The reconstruction of *Struthiomimus* errs in representing the forearm in the position in which it is mounted, namely with the elbow drawn well in toward the body and with the dorsum of the manus turned fully outward. That this position is erroneous is apparent from the fact that the head of the humerus is thereby wrenched out of the glenoid and appears exposed in the lateral view. By placing the head of the humerus fully within the glenoid, everting the elbows and opening the radio-humeral angle, the manus will be partly pronated."

"We speak of the fore limb of *Struthiomimus* as 'slender', but it is so only because the longitudinal dimensions of the principal elements greatly exceed their transverse dimensions. The fore limb is, however, by no means weak. It is at least as strong as the fore limb of a man and was armed with very large sharp claws."

"With the elbows everted in reptilian fashion and the body swung downward from the acetabulum, the powerful manus could be brought near to the ground, although I think there was not sufficient mobility for the fingers to be extended so that the palm could rest upon the ground. But I believe that the animal could stoop down and with its powerful claws tear up shrubs from the ground and perhaps scrape away the surrounding earth by the sweeping movements of the whole forearm after the fashion of a kangaroo. These heavy claws might also have been useful in tearing off the husks of fruits or for tearing and pulling down the branches and fruits of palms, cycads, figs, bananas, etc. Perhaps the claws served also as weapons of defense, if they were swiftly drawn across the flanks of an opponent. The pulling up of vegetation from the ground and the tearing of husks would be assisted by the broad, ostrich-like beak and the powerful neck, which was capable of strong vertical movements."

"Some features of the fore-limbs might indicate that *Struthiomimus* was a climbing animal, but the large size of the body and the nonprehensile character of the pes are against this view."

"The jaws of *Struthiomimus* unquestionably suggest those of an ostrich, and the animal seems too large to thrive exclusively upon an insectivorous diet. *Struthiomimus* was not necessarily exclusively a vegetarian. The ostrich itself is said to be omnivorous in the wild state, feeding on lizards, small mammals, fruits, berries, seed grass, etc., and the slightly more powerful beak of *Struthiomimus* might have been equally adapted for a varied diet, including some animal food."

"The fact that the remains of *Struthiomimus* were found in littoral deposits does not in my judgment indicate that the animal lived after the fashion of wading and shore-living birds."

"In conclusion we can be sure only that *Struthiomimus* was a swift running biped; that in seeking its food it made well-coördinated use of its ostrich-like bill, powerful neck, and strong, heavily clawed manus; that a good deal of pulling and clawing was accomplished by these wide-reaching fore limbs."

"The animal seems to be too big for arboreal life, and its hind limbs were built rather for great speed on the ground, purely as a protective function. It seems possible that the fore limbs bore a narrow patagium, which might be of use in rapid flight along the ground as indicated in the accompanying restoration (Fig. 16). By throwing the head and forearms well forward the thrust of the femora would be turned more forward than upward, while at the same time the forearms if provided with patagia would serve to keep the fore part of the body from pitching downward."[1]

Author's conclusion. The above observations by the several expert anatomists who have coöperated with the author in attempting to solve the very difficult problem of the habits of *Struthiomimus* indicate a very great diversity of opinion and interpretation. The author adheres to the opinion, very gradually formed, that *Struthiomimus* presents prevailing analogies of structure in the head, neck, and feet, and consequently of habit, to the ostriches. Its fore limb structure, entirely unique among reptiles, is analogous partly to the suspensory type of fore limb such as we observe in the tree sloths, with the exception of the phalanges of the pollex, Digit I, which are set apart from the other digits and exhibit a grasping or opposable function.

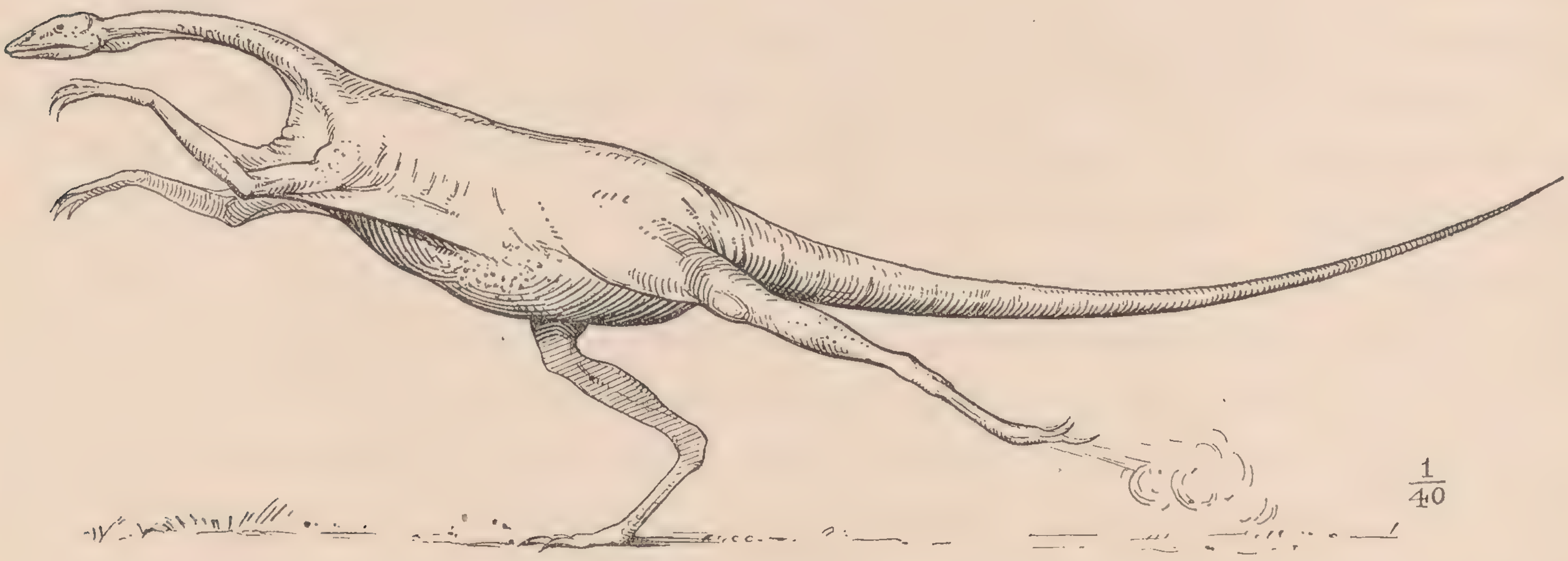

Fig. 16. Running pose of *Struthiomimus*, with a rudimentary patagium as suggested by W. K. Gregory. One-fortieth natural size.

Comparison of the *Struthiomimus* manus with that of the fossorial anteaters (Myrmecophagidæ) shows that the structure is totally different, for anteaters and, in fact, many other fossorial animals are *anisodactylous*, that is, the different digits vary greatly in length, in size, and in the development of the claws, whereas in *Struthiomimus* we have the *isodactyly* peculiarly suited to the suspensory, limb-grasping power of arboreal types. This does not preclude fruit- and shrub-grasping powers, but appears to exclude the grasping of living or actively moving prey.

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[1] Notes by Wm. K. Gregory, 1916.

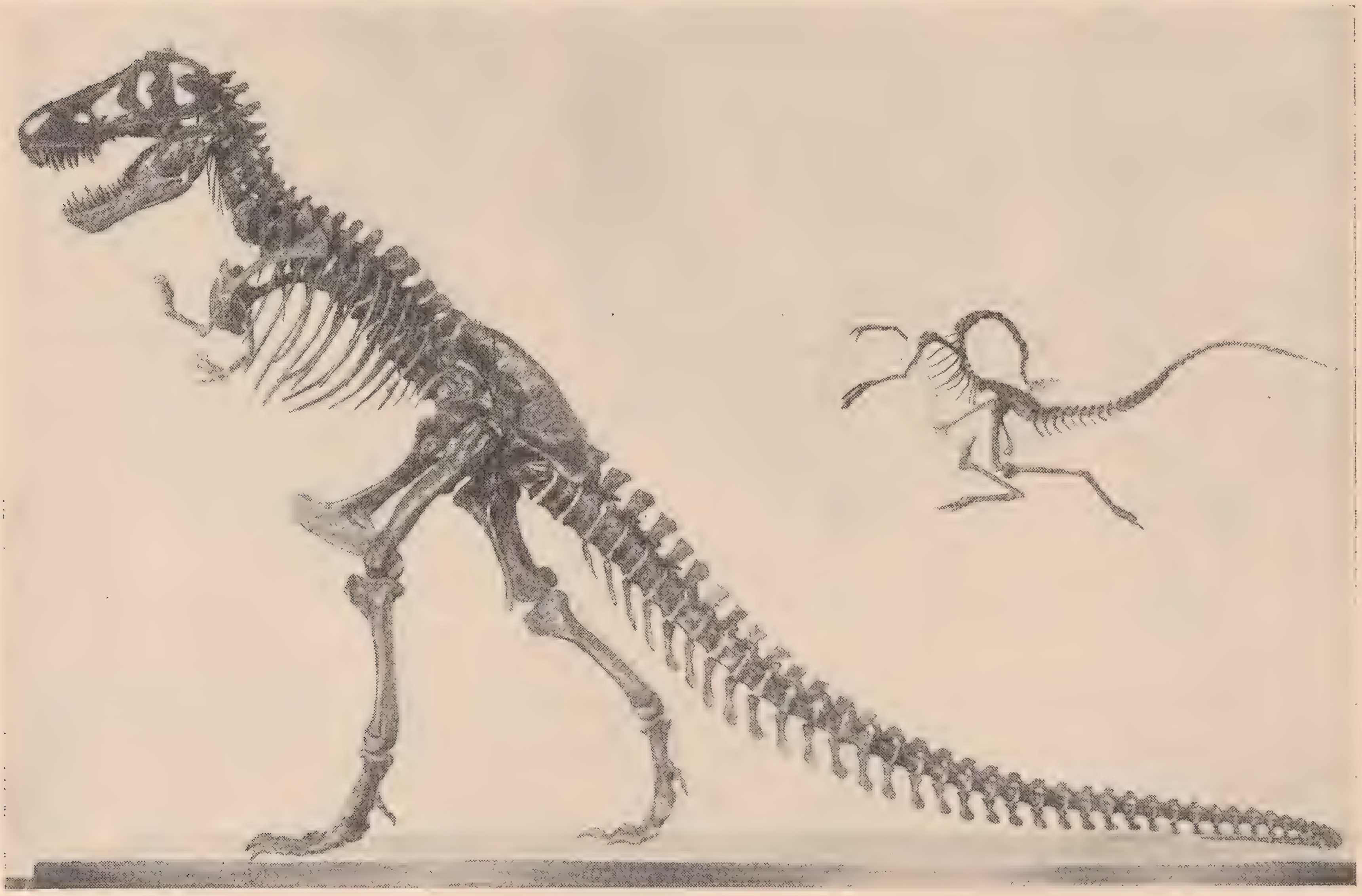

Fig. 17. *Tyrannosaurus* and *Struthiomimus* mounted skeletons, reproduced to same scale, about one-seventy-fifth natural size, and showing relative size and proportions of the fore and hind limbs.

THIRD STUDY OF TYRANNOSAURUS.

INDETERMINATE TYPE OF *Manospondylus gigas* COPE 1892.[1]

The genotype (Amer. Mus. Cope Coll. 3982) of *Manospondylus* originally consisted of two dorsal vertebræ, which Cope recorded verbally to Hatcher[2] as from South Dakota. Of these original two dorsal vertebræ one was figured by Hatcher (*op. cit.* p. 114, fig. 105) and correctly referred to the Theropoda. Unfortunately the remaining vertebra has been misplaced in or lost from the American Museum collections. It most nearly resembles in size and other characters the posterior cervical or first dorsal of *Tyrannosaurus rex* (Amer. Mus. 5866). The comparison with the measurements given by Cope is as follows:

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[1] Cope, E. D. "Fourth Note on the Dinosauria of the Laramie." *Amer. Naturalist*, Vol. XXVI, Sept. 1892, pp. 756–758 (p. 757).

[2] Hatcher, John B. (with O. C. Marsh and R. S. Lull) "The Ceratopsia." *Monogr. U. S. Geol. Surv.*, Vol. XLIX, 1907.

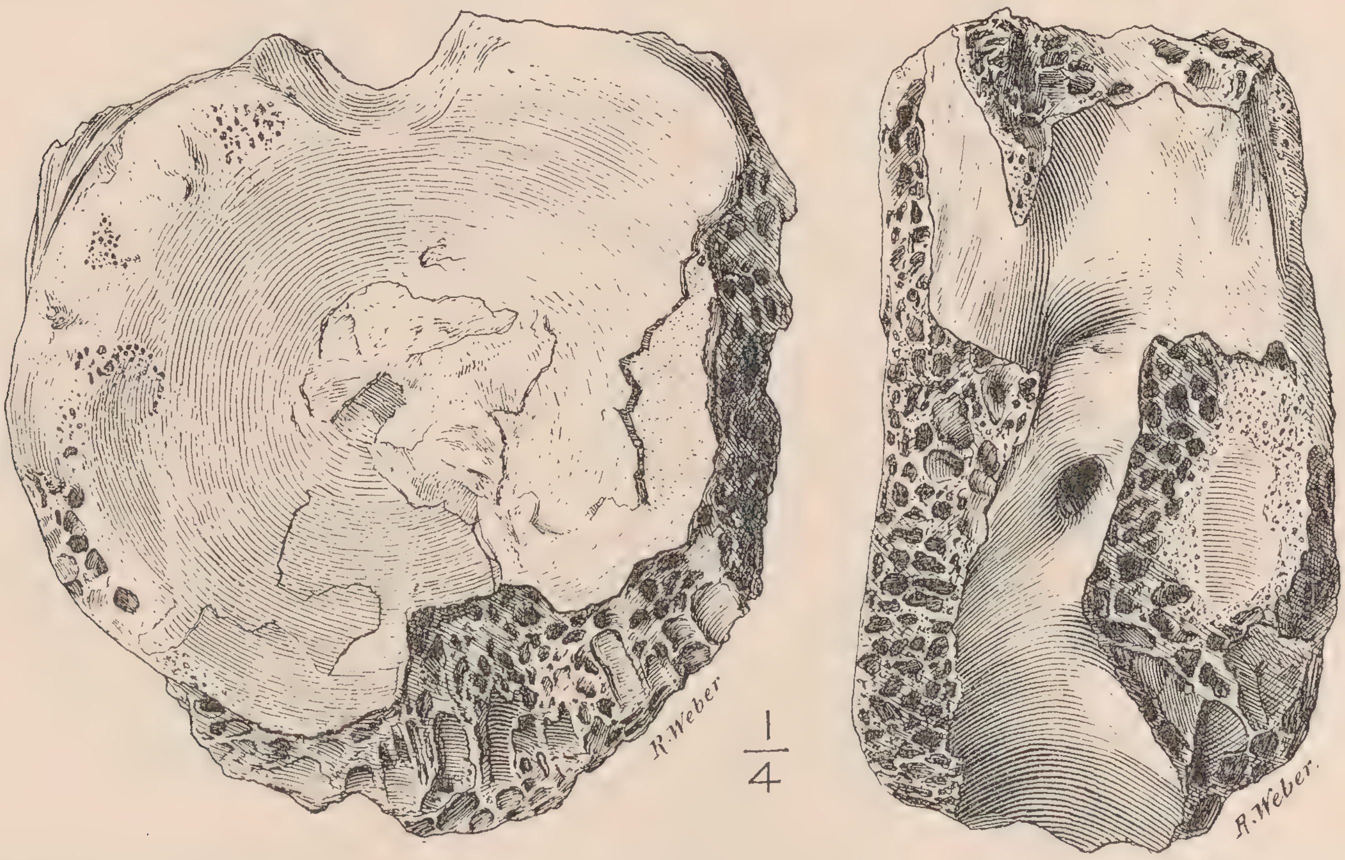

Fig. 17*a*. Vertebral centrum of *Manospondylus gigas* Cope, type, Amer. Mus. Cope Coll. 3982. One-fourth natural size. After Hatcher, 1907.

	Diameters of Centrum	
	Type 3982 *Manospondylus gigas* Cope ? Cervical	Amer. Mus. 5866. *Tyrannosaurus rex* 10th Cervical
Articular face, vertical	.205	.175
Articular face, transverse	.200	.167
Antero posterior	.090	.110

This type is so incomplete and so imperfectly preserved that the genus and species which were founded upon it are regarded as indeterminate.

SKELETON OF TYRANNOSAURUS REX OSBORN.

Text-figs. 17–21, Plates XXV, XXVII.

Tyrannosaurus is the most superb carnivorous mechanism among the terrestrial Vertebrata, in which raptorial destructive power and speed are combined; it represents the climax in the evolution of a series which began with the relatively small and slender Triassic carnivore *Anchisaurus*.

Materials. The fortunate discovery of two skeletons of exactly the same size (Amer. Mus. Nos. 973, 5027), secured by the American Museum of Natural History expeditions to Hell Creek, Montana, in the years 1902 and 1908 respectively, affords complete knowledge of all parts of the skeleton except the sternal ribs, the fore arm, and the manus. The mounted animal here represented (Fig. 15, Plate XXV) is chiefly composed of the specimen found in 1908, Amer. Mus. 5027, with the missing complementary parts, especially the humerus and the femur, cast from the genotype specimen Amer. Mus. 973, discovered in 1902.

Mounting.[1] The anterior, lateral, and posterior aspects of this remarkable mount are shown in Plate XXV, reproduced from the superb photographs taken by Mr. A. E. Anderson in 1915 which were subsequently perfected by his skilful retouching of the negatives whereby all trace of the powerful steel frame work which supports the mounted skeleton has been removed. The absolutely perfect skull of this specimen (Amer. Mus. 5027), which has been described in great detail by Osborn (1912),[2] is not mounted with this specimen because of its great weight but is replaced by a *fac simile* cast. The pose of this animal has been the subject of prolonged study by the author[3] with the coöperation especially of Mr. Barnum Brown and Mr. Erwin Christman. It is proposed ultimately to mount the pair of skeletons in the offensive and defensive attitudes respectively.

Resemblances to the Ornithomimidæ. The resemblances which the skeleton of *Tyrannosaurus* presents to that of *Struthiomimus* and *Ornithomimus* are due to inheritance from a remote common ancestor of Lower Jurassic or even Triassic age. The many striking differences are due to the extremely wide divergence in the habits and adaptations of these animals, and are here represented in a form preliminary to more complete description in a memoir. The chief resemblances are the following:

1. A similar vertebral formula, namely: C 9–10, T 14–13, S 5.
2. Ornithic adaptation of the pelvic arch and sacrum, and a close analogy in adaptation to bipedal locomotion, cursorial and saltatory.
3. Functional tridactylism of the pes with strong reduction of DI, and lateral compression of Mts. III between Mts. II, IV.
4. Relatively feeble development of the fore limb.
5. Retention of a complete series of sternal ribs.

The obvious ancestral resemblances cease or are masked by the widely divergent adaptations of *Tyrannosaurus* to exclusive carnivorous habits and aggression, and of *Struthiomimus* and *Ornithomimus* probably to herbivorous habits and defencelessness, compensated for, doubtless, by alert powers of vision and rapid locomotion. The relative scale of development

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[1] The work of mounting was performed, under the direction of the author and of Mr. Barnum Brown, by Mr. Charles Lang.

[2] Osborn, H. F. "Crania of *Tyrannosaurus* and *Allosaurus*." Mem. Amer. Mus. of Nat. Hist., N. S., Vol. I, Pt. i, June, 1912, pp. 1–30, pls. i–iv, figs. 1–27.

[3] "*Tyrannosaurus*, Restoration and Model of the Skeleton." Bull. Amer. Mus. of Nat. Hist., Vol. XXXII, Art. iv., Apr. 11, 1913, pp. 91–92, pls. iv–vi.

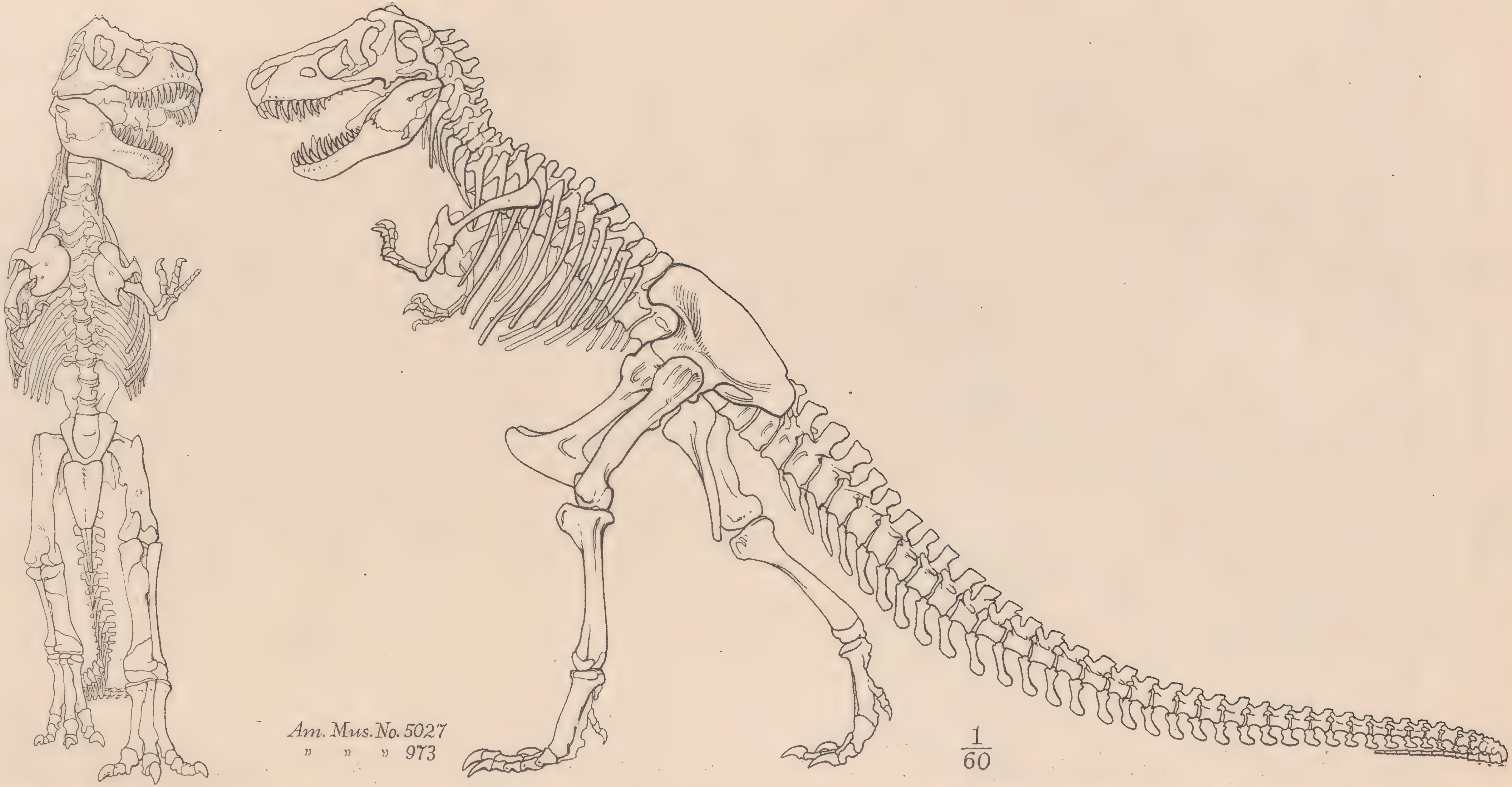

Fig. 18. Mounted skeleton of *Tyrannosaurus rex* Osborn, anterior and lateral views. One-sixtieth natural size. The structure of the manus is conjectural. The other parts are mounted by combination of the skeletons Amer. Mus. Nos. 5027, 973. The sternal ribs are omitted. The manus is represented as tridactyl, but it may be didactyl.

of the skull and the various parts of the skeleton in these two types of animals is well shown in the accompanying figures (Fig. 17), both one-seventieth natural size.

ADAPTIVE DIVERGENCES AND CONTRASTS.

Tyrannosaurus.	*Struthiomimus.*
Extremely large-headed, megalocephalic	Extremely small-headed, microcephalic
Dentition powerful, of extreme raptorial, carnivorous type	Dentition atrophied, jaw sheathed in horn, probably of herbivorous type
Neck extremely abbreviated, cervical ribs elongated, loosely articulated	Neck extremely elongated, cervical ribs coalescent, with narrow centra, flexible.
Fore limb greatly abbreviated, small, prehensile manus with powerful recurved phalanges	Fore limb moderately elongate, extremely slender, isotridactyl, phalanges greatly elongated, straightened, non-prehensile of living prey
Hind limb very powerful with subprehensile phalanges, recurved claws	Distal segments and metatarsals greatly elongated. Non-prehensile.

CHIEF CHARACTERS OF THE TYRANNOSAURUS SKELETON.

In a previous description of the *Tyrannosaurus* skeleton (1906) [1] a preliminary description was given of the parts preserved in the genotype (Amer. Mus. 973). The present description is based upon the parts preserved in both the specimens (Amer. Mus. Nos. 973, 5027).

Pre-sacral vertebræ (Plate XXVII). There is little doubt that the total number of pre-sacral vertebræ is twenty-three, but the line of division between the cervicals and the thoracics is not positively demarkated. The formula is either:

Cervicals 9, Thoracics 14 = 23, or Cervicals 10, Thoracics 13 = 23.

On the whole, close examination of C 10 appears to indicate that this should be regarded as the posterior cervical, since the capitulum of the rib is depressed as in C 9–5, whereas in the first thoracic, D 1, the capitular and tubercular articulations of the rib are widely separated as in the thoracics D 2–D 9.

Cervicals. The cervical series, C 1–10, is extremely abbreviated by the fore-and-aft compression of the vertebræ. C 1 (atlas) is extremely short, C 2 (axis) has a somewhat more elongate centrum, with a bifid spine,

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[1] Osborn, H. F. "*Tyrannosaurus*, Upper Cretaceous Dinosaur." Bull. Amer. Mus. of Nat. Hist., Vol. XXII, Art. xvi, July 30, 1906, pp. 281–296.

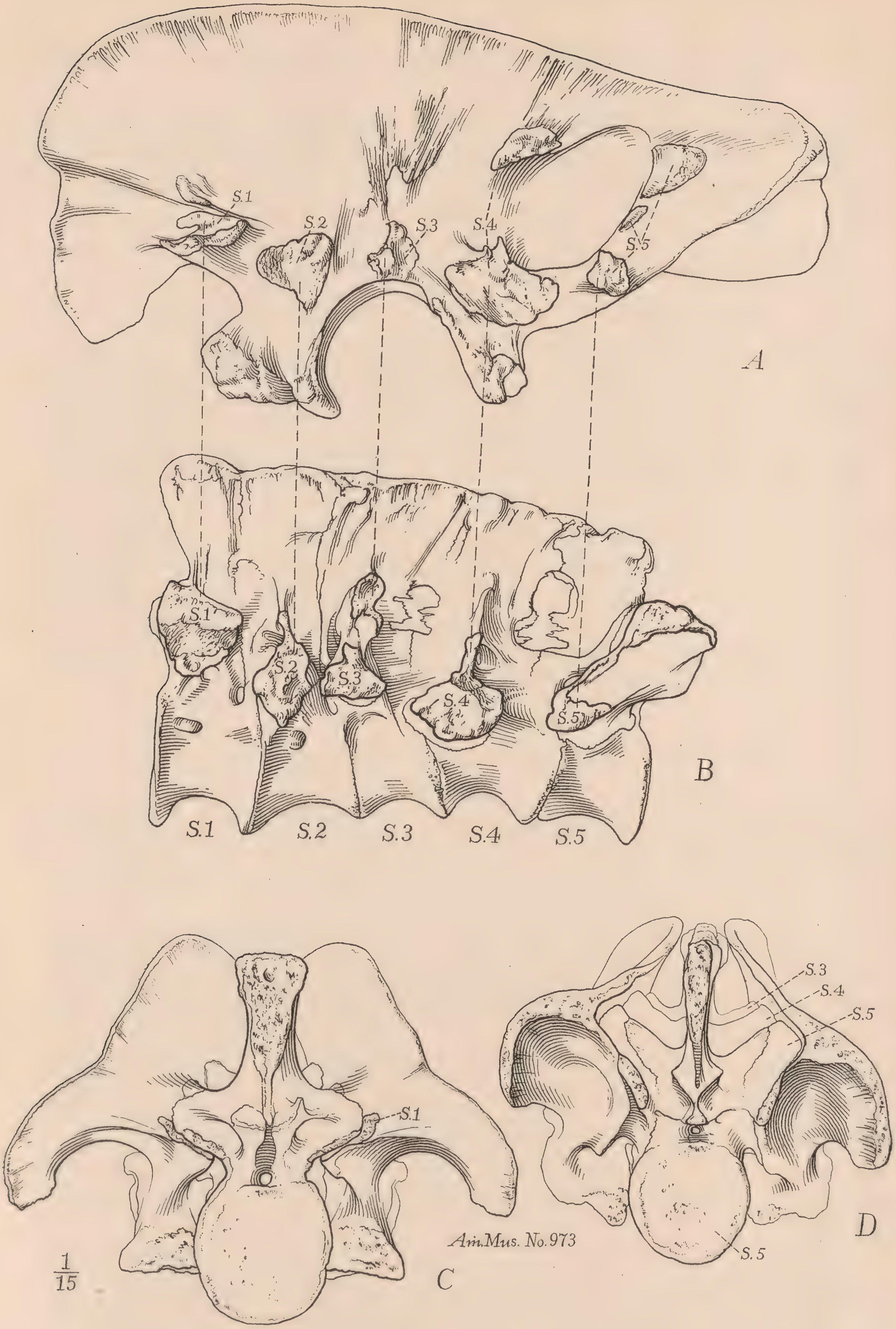

Fig. 19. Sacro-pelvic arcade of *Tyrannosaurus rex* of the genotype specimen Amer. Mus. 973, discovered in Hell Creek, Montana, in 1904. A, Sacral aspect of the right ilium showing the respective attachments of the five sacrals S 1–5. B, Left lateral aspect of the sacrum, exhibiting centra of S 1–5, also the sacral rib attachments S 1–5 to the inner aspect of the left ilium. C, Anterior aspect of the sacro-iliac arcade, S1, the first sacral vertebra. D, Posterior aspect of the sacro-iliac arcade showing S5, the fifth sacral. All figures one fifteenth natural size.

coalesced intercentrum, and a monocipital rib, C 3 exhibits a powerful spine and a bicipetal rib (as partly restored). In C 5–C 10 the neural spines gradually diminish in height; lateral cavities (pleurocœlia) appear at the sides of the centra; the tubercular processes of the ribs expand into a broad tuberculo-capitular head, in which the capitulum is abbreviated and no longer articulates with the posterior face of the centrum in front. The centra of the last cervical and the first dorsal, D1, are more or less coalescent.

Thoracics or dorsals. The ten successive vertebræ exhibit the following characters: (1) the centra progressively elongate; (2) the faces are amphiplatyan or slightly opisthocœlous; (3) lateral cavities (pleurocœlia) are present in D 2, are faint in D 3, D 5, present in D 6, D 13, rising gradually from the middle of the centrum in D 4 to the top of the centrum in D 13; (4) the capitular articulations of the ribs rise from near the base of the centrum in D 1 to the middle of the neural arch in D13; (5) the articulations for the tubercles of the ribs are elevated on the metapophyses (transverse processes) throughout, diminishing in size from D 1–D 12, in which the capitular and tubercular processes are brought nearer together. The under surfaces of the metapophyses are sculptured and pitted with two facets or cœlia; (6) the neural spines increase steadily in size from D 1–D 13; (7) between D 7 and D 13 there is a tendency of the adjacent neural spines to coalesce at the summits; (8) in D 9–D 12 there are traces of a neurocentral suture; (9) the metapophyses of D 12–D 13 tend to unite with the antero-internal face of the iliac crest (Fig. 17); (10) the centrum of D 13 tends to unite with that of the first sacral (Fig. 17).

As a whole the pre-sacral series, the cervico-thoracic, is greatly abbreviated so that the extremely heavy and powerful skull is brought very near the powerful sacral arcade.

Sacral vertebræ (*Figs. 19, 20, Plate XXVII*). Of the two superbly preserved sacral arcades that of the first specimen (Amer. Mus. 973) shows best the normal condition of the five sacral vertebræ since the second specimen (Amer. Mus. 5027) is unnaturally compressed and deformed. It is noteworthy that the five vertebræ composing the sacrum coalesce by their centra, also that S 2, S 3 are laterally compressed, as shown normally in Amer. Mus. 973. S 1 is directly opposite the anterior (pubic) peduncle of the ilium, while S 3 is opposite the posterior (ischiac) peduncle of the ilium. These are probably the primary sacrals, while S 4, S 5 are probably caudo-sacrals. The sutures between the sacral centra and sacral ribs are still apparent in the ventral view of Amer. Mus. 973. An instructive view of the sacro-iliac arcade is shown in Plate D, in which it is observed also that the anterior (pubic) and posterior (ischiac) peduncles of the ilium coincide with S 1 and S 3 respectively.

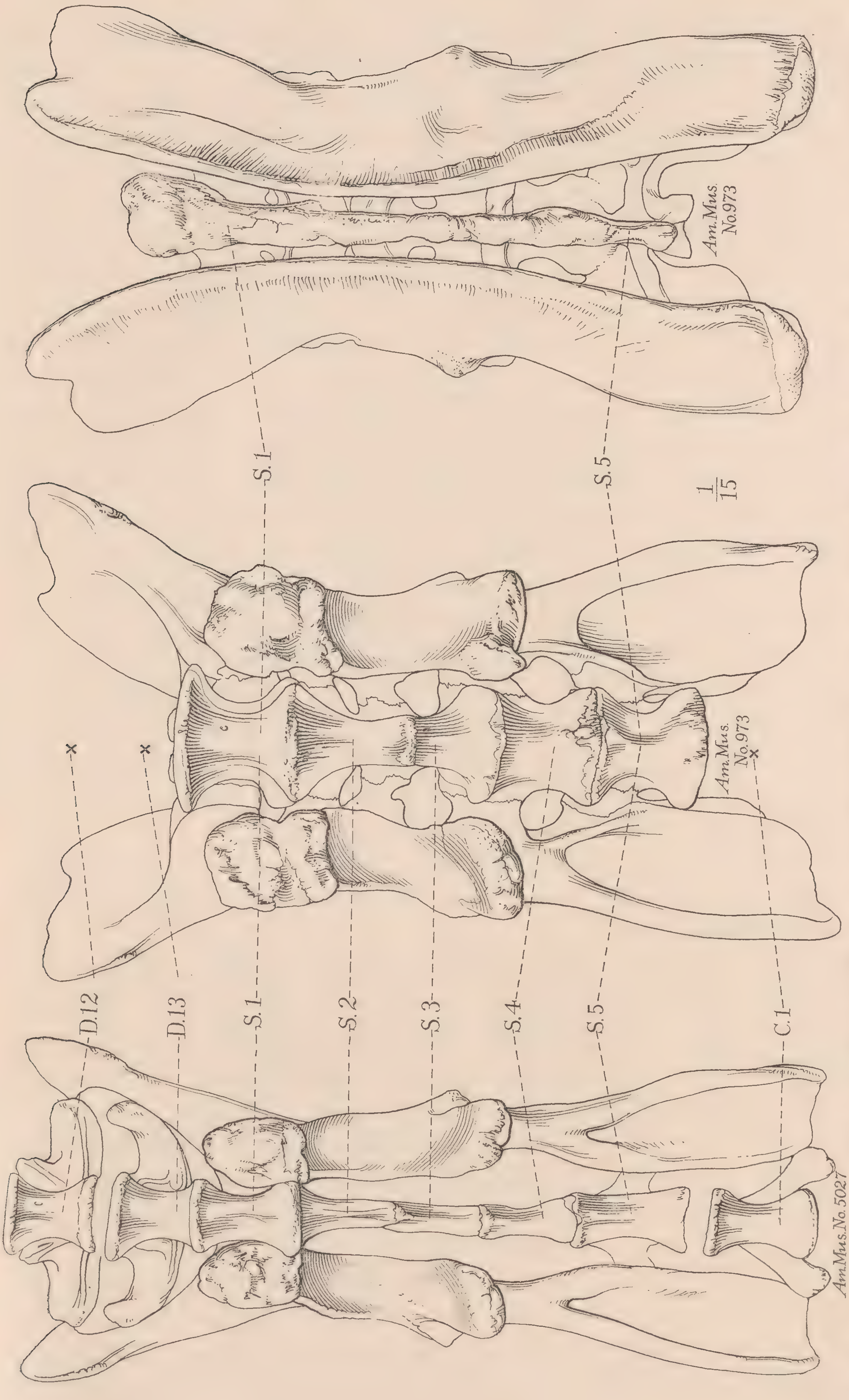

Fig. 20. Comparative views of the sacro-iliac arcade in *Tyrannosaurus rex*. To the right, superior and inferior views of the type specimen Amer. Mus. 973. To the left, inferior view of the second specimen, Amer. Mus. 5027, including dorsals, D12, 13, also the first caudal, C1. S2, S2–5 are strongly crushed laterally, deforming their proportions.

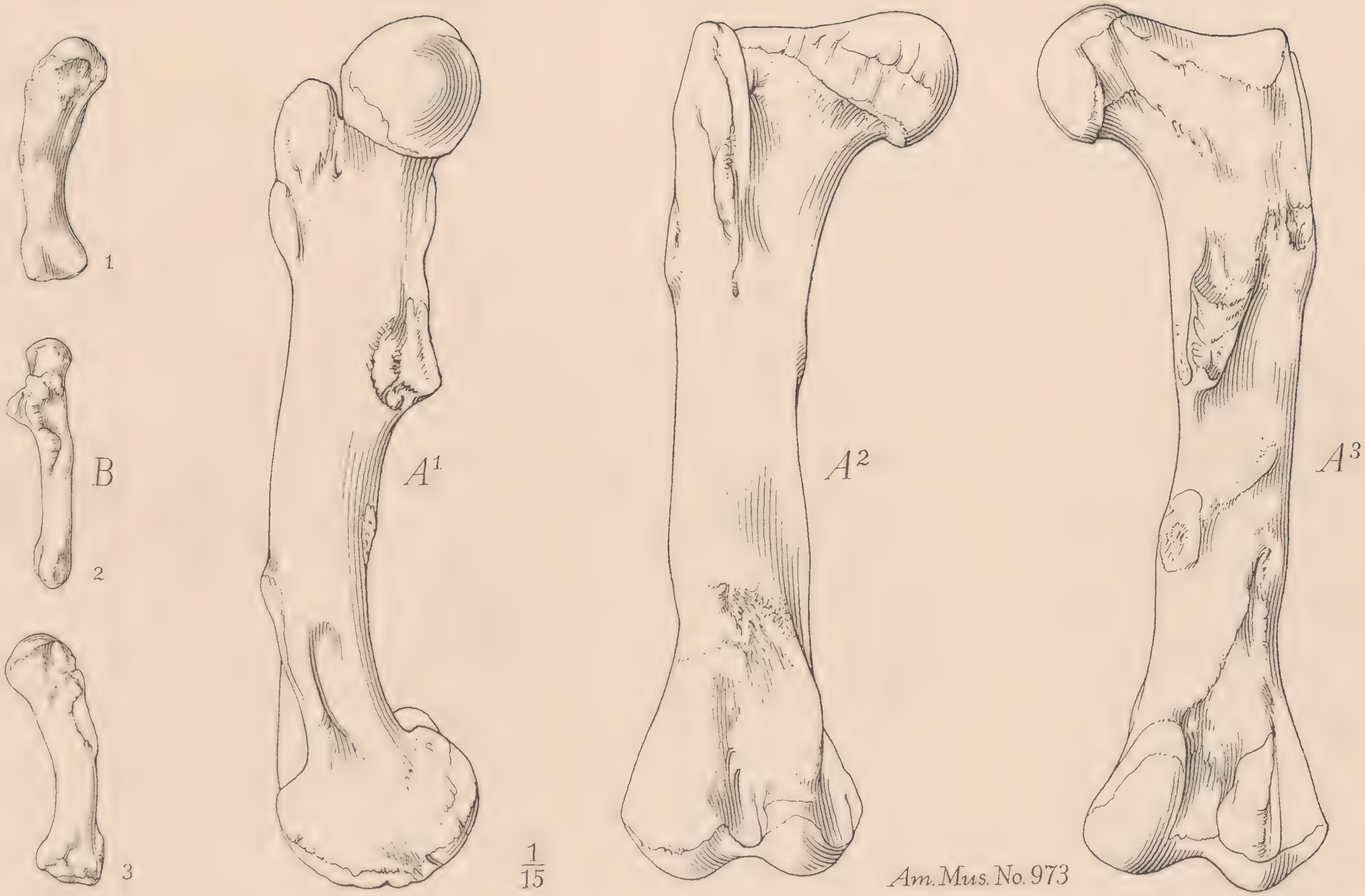

Fig. 21. Humerus and femur of *Tyrannosaurus rex*, type specimen Amer. Mus. 973. One-fifteenth natural size. B Humerus in three aspects, (1) posterior, (2) exterior, (3) anterior. A¹ right femur, internal aspect, A² the same, anterior aspect, A³ the same, posterior aspect. One-fifteenth natural size.

Caudal vertebræ (*Fig. 17, Plate D*). The anterior caudal, C 1 (Fig. 17), partly unites by its caudal rib with the horizontally expanded internal plates of the ilium (Fig. 17, Amer. Mus. 5027). The caudal series so far as preserved in the specimen (Amer. Mus. 5027) is represented in the shaded vertebræ figured in Plate D, namely C 1–C 15, C 17, ?C 21–22. The intermediate vertebræ as well as the terminal vertebræ, C 23–53, are conjecturally restored. As in other carnivorous dinosaurs the caudals gradually diminish in size and increase in relative length. The centra are amphiplatyan or slightly procœlous. Neuro-central sutures are observed in Cd 2, Cd 11. The tail is an elongate balancing organ for the anterior part of the body, having considerable flexibility and exhibiting no indications of the extreme rigidity observed in the inflexible tail of the Ornithomimidæ.

Sternal ribs. Remnants of the doubly paired, or more probably triply paired series of abdominal ribs are preserved with specimen Amer. Mus. 973 and have already been described (Osborn, 1906). Brown observes:[1] "As yet we cannot definitely say as to the triply paired disposition of the abdominal ribs in *Tyrannosaurus* although I doubt not that this was the placement. It is true in all other forms in which the abdominal plates are found in position, and when the median series of abdominal ribs of *Tyrannosaurus* are placed in position the ends do not reach the costal ribs, so that it appears that there were two additional abdominal rib segments on each side."

Problematic Dermal plates. The dermal plates previously described by Osborn (1906) are still unique in the American Museum collections; they are totally unlike those of the armored herbivorous dinosaurs or the armored Ceratopsia. In a type specimen of *Ceratosaurus* recently mounted in the U. S. National Museum there is part of a row of dermal plates present above the tips of the neural spines. It is, therefore, quite possible that plates of the character attributed by Osborn to *Dynamosaurus* (= *Tyrannosaurus*) extended down over the sides of the body.

Pelvic arcade (Fig. 17, Plate XXVII). The pelvic arcade is distinguished by the following characters: (1) the antero-posterior extension of the ilium; (2) the firm articulation of the ilium with the sacral ribs (Fig. 16, S 1–S 5); (3) the articulation of the ilium with the metapophyses of the three posterior sacrals (Fig. 16, S 3–S 5); (4) the anterior expansion of the iliac plates (Fig. 16 C); (5) the postero-internal iliac horizontal plates (Fig. 16 D).

The pubis, firmly coalesced with the ilium and ischium, terminates in an enormously expanded peduncle. The ischium is comparatively slender with contracted rod-like extremity.

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[1] Brown, Barnum. Letter to the author Jan. 7, 1916.

Fore limb. The great disparity between the fore limb and hind limb is illustrated in the contrast (Fig. 18) between the humerus (B) and the femur (A^1, A^2, A^3) of the genotype specimen (Amer. Mus. 973).

As to the number of digits in the still unknown manus of *Tyrannosaurus* Gilmore regards it as probable that *Tyrannosaurus* will prove to be functionally didactyl with a vestigial D III as in the genus *Gorgosaurus*, in which D III is reduced to a vestige being represented only by Mtc. III without phalanges. It has recently been shown by Gilmore and Lambe that the manus of the Theropoda is greatly reduced not only in size but in the number of its parts.

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digits, see Fig. 3.

Skeleton of *Struthiomimus altus*. Genotype specimen, Amer. Mus. 5339. One-tenth natural size.
In this panel mount the animal is placed approximately as found. The pollex is too closely appressed to the other digits, see Fig. 3.

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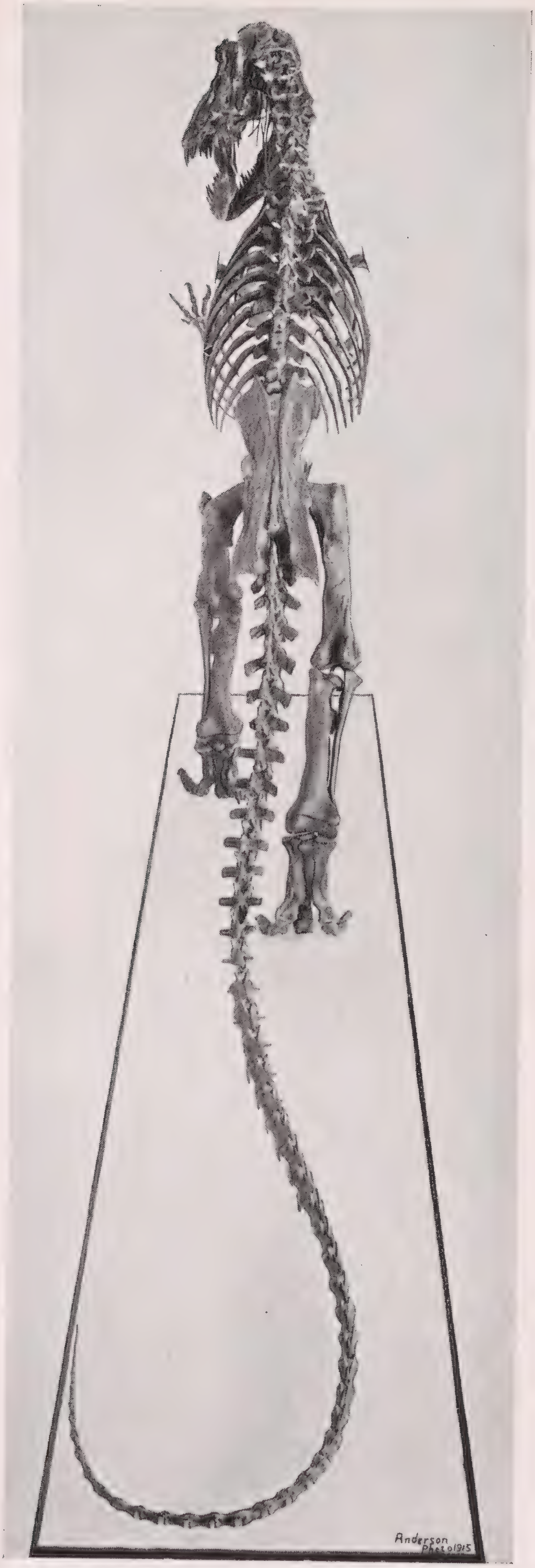
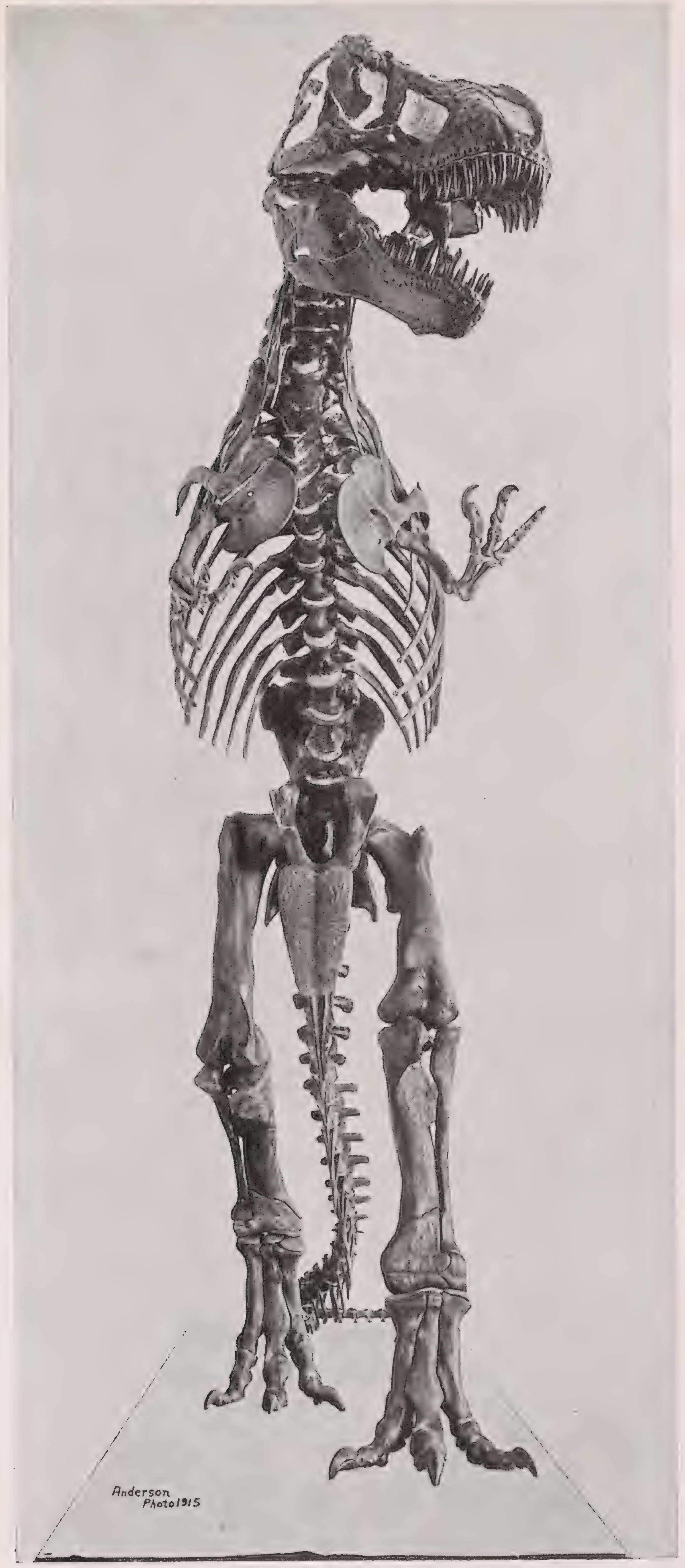
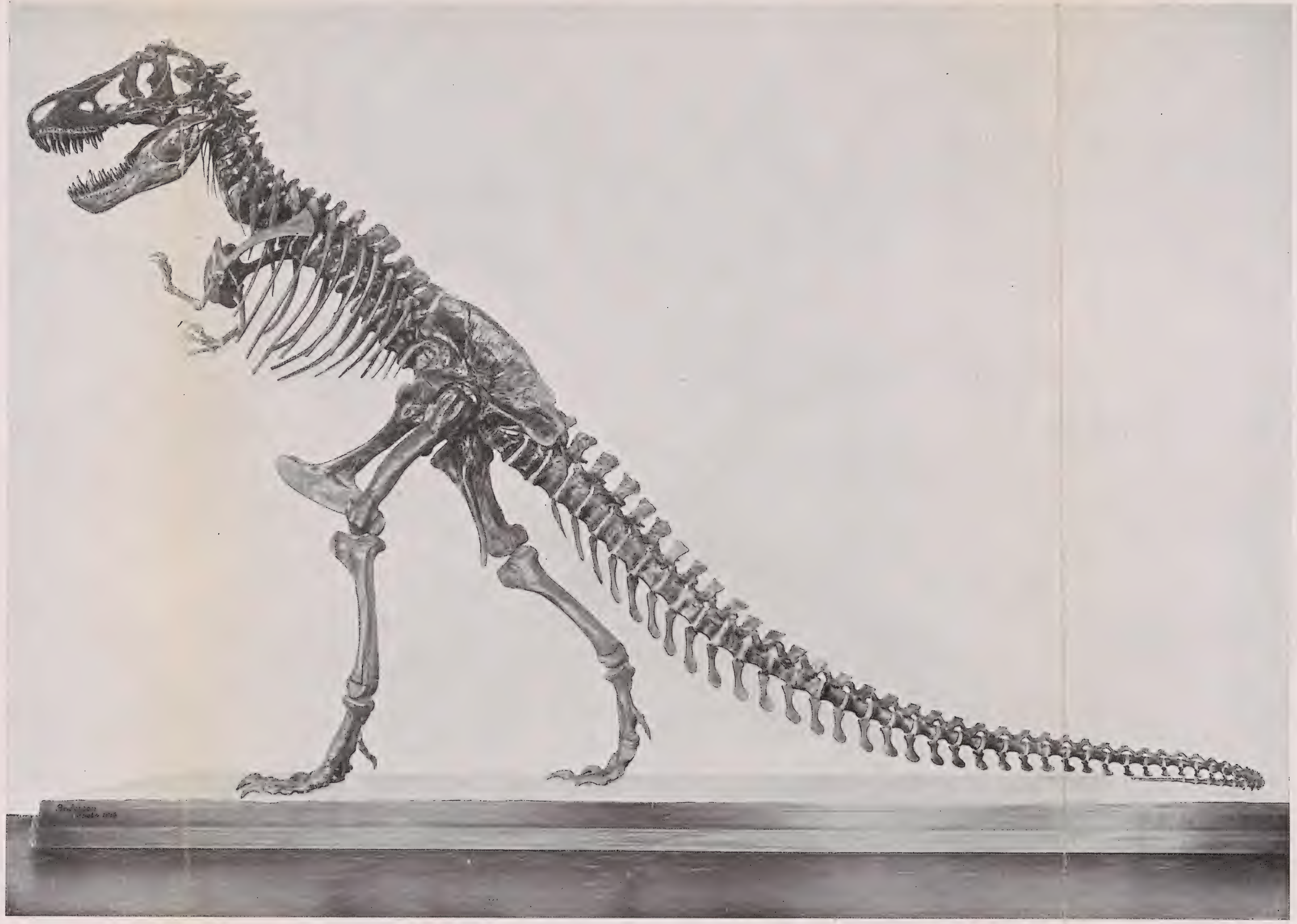
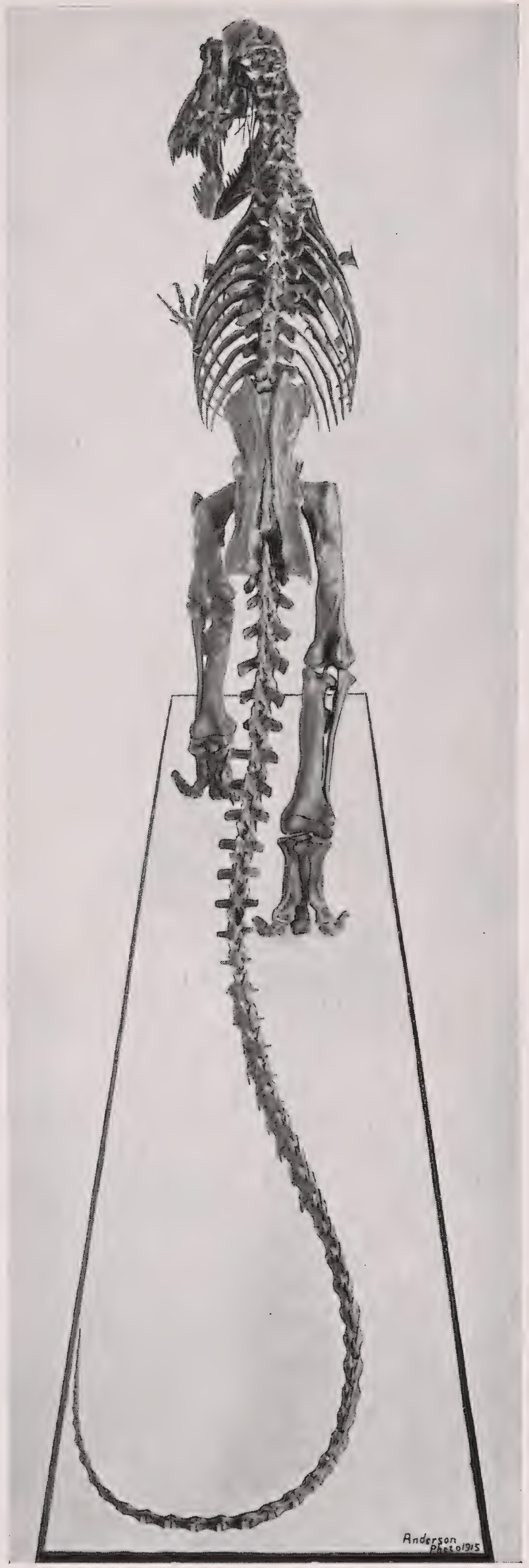
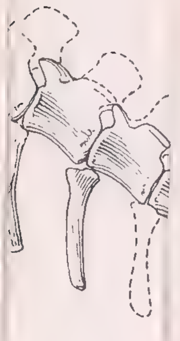








Anterior, lateral, and posterior aspects of the mounted skeleton of *Tyrannosaurus rex*, chiefly from Amer. Mus. 5027, partly from the type specimen Amer. Mus. 973. The sternal ribs are not restored. The structure of the manus is unknown as yet; the restoration of the digits is conjectural. About $\frac{1}{53}$ natural size.



Reconstruction of the skeletons of *Struthiomimus altus* (left) and *Ornitholestes hermanni* (right). *Struthiomimus* $\frac{1}{10}$, *Ornitholestes* $\frac{1}{6}$ natural size.
The *Ornitholestes* restoration replaces the original restoration by Osborn in 1903 which is very faulty.
The *Struthiomimus*, Amer. Mus. 5339, mount has the distal end of the tail restored from Amer. Mus. 5355; dotted vertebræ from Amer. Mus. 5262.
In both restorations the pollex is too closely appressed to the other digits, see Fig. 3.

6

Pelvic arcade and vertebral structure of the second chief specimen of *Tyrannosaurus rex*, Amer. Mus. 5027, discovered in 1908. An orthogonal projection executed on a very large scale and reproduced one-twelfth natural size. C 1–C 10 cervical series, D 1–D 13 dorsal or thoracic series, S 1–S 5 sacral series, Cd 1–Cd 53 caudal series. The caudals actually preserved are shaded; those drawn in outline are conjectural and restored. The total number of caudals is conjectural.

INDEX TO VOLUME XXXV.

New names of genera, subgenera, species, and snbspecies are printed in **heavy-faced type**, also the main reference in a series of references.

ABALONE, 447.
Abudefduf saxatilis, 169.
Acromyrmex emilii, 11.
Adapidæ, 261.
Æpeomys fuscatus, 198, 215.
Agouti paca (near sierræ), 206.
  paca taczanowskii, 205.
  paca virgata, 205.
  sierræ andina, 115.
Akodon caliginosus, 115.
  chapmani, 198, 216.
  mollis altorum, 120.
  tolimæ, 198, 216.
Albatross, narrative of voyage to Gulf of California in 1911, 399–433.
Albula vulpes, 149.
Allen, J. A., the proper generic name of the Macaques, 49–52; new South American mammals, 83–87; the Neotropical Weasels, 89–111; a list of mammals collected for the American Museum in Ecuador by William B. Richardson, 1912–1913, 113–125; list of mammals collected in Colombia by the American Museum of Natural History expeditions, 1910–1915, 191–238; new mammals collected on the Roosevelt Brazilian Expedition, 523–530; mammals collected on the Roosevelt Brazilian Expedition, with field notes by Leo E. Miller, 559–610.
Allops **walcotti** 721.
Alouatta æquatorialis, 231.
  caraya, 586, 603.
  insulanus, 233.
  palliata inconsonans, 374.
  seniculus, 230, 603.
  seniculus bogotensis, 199, 230, 231.
  seniculus caquetensis, 199, 231.
Alouatta seniculus caucensis, 230, 603.
  seniculus macconnelli, 230, 233.
  seniculus rubicunda, 231.
  seniculus rubiginosa, 229.
Amia **guadalupensis**, 160.
  retrosella, 160.
Ammospermophilus leucurus peninsulæ, 418.
Amorphochilus schnablii schnablii, 124.
Amphilestes, 241.
Amphisbæna punctata, 660.
Amphitherium prevostii, 246.
Anaptomorphidæ, 263.
Andrena (Andrena) **beutenmuelleri,** 729.
  (Andrena) **discolor,** 730.
  (Andrena) **edwardsi,** 731.
  (Andrena) **idahorum,** 732.
Anisotremus davidsoni, 164.
  interruptus, 164.
Anochetus mayri, 3.
  (Stenomyrmex) emarginatus, 3.
Antechinomys laniger, 246.
Anthony, H. E., habits of *Aplodontia*, 53–63; Panama mammals collected in 1914–1915, 357–376; preliminary diagnosis of an apparently new family of Insectivores, 725–728.
Anthropodus brancoi, 310.
Anthropoids and man, chief adaptive characters of the skull, dentition and limbs, 272–280.
Anthropopithecus (Pan), 313.
Anthus antarcticus, 40.
Aotus aversus, 234.
  azaræ, 587, 606.
  griseimembra, 235.
  lanius, 235.
  lemurinus, 234.

Aotus pervigilis, 235.
  roberti, 587, 606.
  vociferans, 234.
  zonalis, 235, 374.
Aplodontia pacifica, 53, 531.
Apternodus, 244.
Apterostigma mayri, 11.
  urichi, 11.
Arbaciosa eos, 178.
  humeralis, 177.
Arctocephalus townsendi, 407.
Argicus macrodactylus **caurensis**, 389.
Artibeus cinereus bogotensis, 226.
  concolor, 583.
  jamaicensis æquatorialis, 226.
  jamaicensis lituratus, 583, 600.
  lituratus, 124, 226.
  toltecus ravus, 124, 226.
  watsoni, 226, 373.
Astroscopus zephyreus, 177.
Atactomima, 15.
  crescentis, 16.
Ateles dariensis, 375.
  longimembris, 587, 605.
  robustus, 199, 235.
Atherinops affinis, 156.
  insularum, 156.
Atherinopsis californiensis, 156.
  sonoræ, 156.
Atta cephalotes, 11.
  sexdens, 11.
  sexdens subsp. lævigata, 11.
Auricomus, 506.
Awaous taiasica, 175.
Azteca instabilis, 12.
  jelskii, 12.
  sericea, 12.

Balistes polylepsis, 172.
Bascanichthys **bascanoides,** 147.
  peninsulæ, 147.
Basiceros singularis, 9.
Bassaricyon alleni, 115.
  medius, 222.
Bequaert, J., Parasitic muscid larvæ collected from the African elephant and the white rhinoceros by the Congo Expedition, 377–387.
Beskia cornuta, 21.
Beskiocephala flava, 17.
Bibiomima handlirschi, 22.
Blarina osgoodi, 116.
  (Cryptotis) squamipes, 199.
Blastocerus bezoarticus campestris, 565, 592.
  dichotomus, 565, 591.
Bogeria, 378.
Bombias, 502.
  mexicensis, 513.
  rufocinctus, 513.
Bombidæ, geographic distribution, with notes on certain species of Boreal America, 501–521.
Bombus, 502.
  alboanalis, 516.
  antiguus, 511.
  appositus, 521.
  arcticus, 520.
  balteatus, 506.
  bolsteri, 515.
  borealis, 520.
  chilensis, 503.
  couperi, 516.
  edwardsii, 514.
  ephippiatus, 517.
  flavifrons, 516.
  frigidus, 516.
  gelidus, 515.
  hyperboreus, 520.
  impatiens, 517.
  kincaidii, 520.
  kirbyellus, 506, 520.
  melanopygus, 515, 519
  mixtus, 516.
  nigrodorsalis, 514.
  occidentalis, 521.
  pennsylvanicus, 514.
  perplexus, 515.
  pleuralis, 516.
  polaris, 520.
  pulcher, 517.
  sitkensis, 516.
  strenuus, 520.
  sylvicola, 515.
  ternarius, 514.
  terrestris, 521.
  terricola, 521.
  wilmattæ, 514.

Boule's conception of *Eoanthropus* and of the ancestral Hominidæ, 345–348.
Brachydeuterus leuciscus, 164.
Brachyistius frenatus, 168.
Brachymyrmex patagonicus, 13.
Bradypterus **carpalis,** 27–29.
Bradypus ephippiger, 116, 202.
  griseus, 202, 364.
  ignavus, 202, 364.
  tridactylus, 563.
Brisinga panamensis, 432.
Brissopsis columbaris, 418.
  pacifica, 415.
Brown, Barnum, a new Crested Trachodont Dinosaur, *Prosaurolophus maximus,* 701–708; *Corythosaurus casuarius:* skeleton, musculature and epidermis, 709–716.
Brues, Charles T., three new species of Evaniidæ, 717–720.

Cabassous loricatus, 564, 591.
Cacajao roosevelti, 588, 607.
Cadea blanoides, 661.
  palirostrata, 659.
Calamus brachysomus, 164, 452.
Callicebus lugens duida, 609.
  ornatus, 228.
Callithrix argentata, 584.
  argentata leucomerus, 585.
  argentata melanura, 583, 603.
Callyodon **compressus,** 171.
  microps, 170.
  noyesi, 170.
  perrico, 169.
Camponotus (Dinomyrmex) agra, 14.
  (Dinomyrmex) moscaryi, 14.
  (Myrmamblys) novogrenadensis, 14.
  (Myrmobrachys) senex, 14.
  (Myrmorhachis) latangulus, 14.
  (Myrmorhachis) rectangularis, 14.
  (Myrmosphincta) sexguttatus var. fusciceps, 14.
  (Myrmothrix) abdominalis, 14.
  (Myrmothrix) rapax, 14.
Canis jamesi, 426.
  peninsulæ, 413.
  sladeni, 561.
Capito auratus **insperatus,** 391.
  dayi, 394.
Captorhinus, 623.
Caranx caballus, 159, 450.
  hippos, 159, 425, 450.
  latus, 450.
Carbo albiventer, 33.
Caulolatilus princeps, 175.
Cavia anolaimæ, 198, 204.
  (Cavia) **anolaimæ,** 85.
  (Cavia) rufescens pamparum, 567.
  (Galea) boliviensis, 567.
  rufescens pamparum, 594.
Cebidæ, 261.
Cebus æquatorialis, 113, 125.
  apella apella, 238.
  apella apiculatus, 238.
  azaræ, 609.
  azaræ azaræ, 588.
  capucinus, 374.
  capucinus nigripectus, 237.
  fatuellus, 237.
  macrocephalus, 588.
Celeus citrinus, 395.
  roosevelti, 183.
Centetes, 251.
Ceramaster leptoceramus, 413.
  patagonicus, 418.
Ceratixodes putus, 47.
Cerdocyon thous azaræ, 574, 598.
  thous, 122, 224.
Cervus bezoarticus, 565.
  cuguapara, 565.
  dichotomus, 565.
  paludosus, 565.
Chænomugel proboscoideus, 158.
Chætodipterus zonatus, 172.
Chætura chapmani **viridipennis,** 183.
Chalcidopterella **manni,** 719.
Chapin, James P., four new birds from the Belgian Congo, 23–29; the Pennant-winged Nightjar of Africa and its migration, 73–81.
Chelonia virgata, 445.
Cherrie, George K., some apparently undescribed birds from the collection of the Roosevelt South American Expedition, 183–190; two new birds from Venezuela, 389; new birds from

the collection of the Collins-Day Expedition to South America, 391–397.
Chilonycteris rubiginosa rubiginosa, 373.
Chimpanzee, 256, 275.
    origin of, 340.
Chironectes minimus, 202.
Cholœpus agustinus, 197–202.
    andinus, 197–202.
    capitalis, 197, 203.
    florenciæ, 197, 202.
    hoffmanni, 202.
Chromis atrilobatus, 168.
    punctipinnis, 168.
Chrysochloris, 244.
Chrysocyon jubatus, 574, 598.
Chrysoexorista viridis **angustifrons**, 21.
Chrysometopiops, 19.
    smithii, 19.
Chrysosturmia, 20.
    orbitalis, 20.
Cicindela, 689.
    argentata, 689.
    argentata var. pallipes, 696.
    boops, 689, 691.
    cardini, 689, **690**.
    cubana, 689, **696**, 697.
    dorsalis var. venusta, 697.
    marginata, 689, 690.
    olivacea, 689, 692.
    suturalis, 689, 693.
    suturalis var. guadeloupensis, 694.
    suturalis var. hebræa, 694.
    trifasciata, 689, 691, 692, 693.
    viridicollis, 689, 695.
Cicindelinæ, systematic position of Antillean, 682–684.
Citharichthys gilberti, 180.
Citula dorsalis, 159.
Clinocottus analis, 174.
Clupanodon cæruleus, 149.
Cobboldia chrysidiformis, 380.
Cockerell, T. D. A., the auditory ossicles of *Aplodontia*, 531, 532.
Cœlodus **syriacus**, 135–137.
Coendu centralis, 561.
    quichua richardsoni, 113, 118.
Coles, Russell J., natural history notes on the Devilfish, *Manta birostris* (Walbaum) and *Mobula olfersi* (Müller), 649–657.
Conepatus feuillei, 573.
    mapurito, 221.
    mapurito monzoni, 573.
    proteus, 573.
    quitensis, 121.
    suffocans, 573.
Congrellus balearicus, 146.
Conodectes favosus, 618.
Cope-Osborn theory of trituberculy, 239–252.
Cordylobia, 379.
    rodhaini, 379.
Corythosaurus casuarius, 709–716.
Cosmetornis vexillarius, 73–81.
Crematogaster acuta, 12.
    brevispinosa var. tumulifera, 12.
    limata subsp. ludio, 12.
    limata subsp. parabiotica, 12.
    longispina subsp. tenuicula, 12.
    quadriformis, 12.
Crocidura bicolor, 666.
    boydi, 663.
    caliginea, 664, 676, 677.
    congobelgica, 670, 676, 678.
    flavescens kivu, 663.
    fumosa, 663.
    hildegardeæ, 663.
    jacksoni denti, 665, 679.
    latona, 667, 676, 677.
    ludia, 668, 676, 678.
    lutrella, 664.
    nigrofusca, 663.
    nilotica, 664.
    nyansæ kivu, 663, 679.
    oritis, 666, 676, 677.
    poensis attila, 663.
    polia, 669, 676, 678.
    sururæ, 664.
    turba nilotica, 664.
    turba tarella, 663.
    turba turba, 663.
Crocomorphus flavus, 395.
    flavus **inornata**, 395.
Crotalus atrox, 426.
    molossus, 428.
Cryptocerus (Cephalotes) atratus, 12.
    maculatus, 11.
    oculatus, 11.
    pusillus, 12.
    spinosus, 11.

Cryptotis thomasi, 224.
Ctenodiscus crispatus, 431.
Ctenodus obliquus, 129, 131.
  ohiensis, 129.
  reticulatus, 131.
  serratus, 130.
Ctenomys nattereri, 569, 595.
Ctenosaura hemilopha, 428, 430.
Cuterebra, 377.
  emasculator, 379.
Cutiterebra, 377.
Cyclopes didactylus dorsalis, 203.
  didactylus eva, 203.
  didactylus ida, 117.
Cylindrophasia, 22.
Cynamologus, 51, 52.
  cynocephalus, 51.
Cynoscion, 417.
  macdonaldi, 450.
  parvipinnis, 451.

Daceton armigerum, 9.
Dactylagnus mundus, 177.
Dactylomys dactylinus dactylinus, 208.
Dactyloscopus **cinctus,** 176.
  lunaticus, 176.
Dasyatis dipterura, 145.
Dasyprocta agouti leptura, 568, 594.
  azaræ, 568.
  croconota croconota, 568.
  exilis, 205, 569.
  fuliginosa candelensis, 198, 205.
  fuliginosa columbiana, 205.
  fuliginosa fuliginosa, 568.
  isthmica, 370.
  (Myoprocta) exilis, 595.
  (Myoprocta) exilis exilis, 569.
  (Myoprocta) exilis milleri, 205.
  pratti, 569.
  variegata chocoensis, 198, 205.
  variegata urucuma, 568, 595.
  variegata variegata, 205.
  variegata zamoræ, 113, 118.
Dasypterus ega punensis, 113, 124.
Dasypus novemcinctus, 203, 563, 590.
  novemcinctus æquatorialis, 115, 203.
Dasythamnus mentalis, 537.
DeBlainville's classification of Primates, 266.
Deinodon grandis, 741.
Dendromyrmex chartifex **felis,** 13.
  fabricii, 13.
  fabricii **rufescens,** 13.
  nidulans **nigripes,** 13.
Dermatobia, 377.
Dermatolepis punctatus, 162, 430, 452.
Desmodus rotundus, 226, 602.
Diadectes, 619–623, 633.
Dickerson, Mary C., description of a new Amphisbænian collected by the late Dr. Charles S. Mead in 1911, on the Isle of Pines, Cuba, 659–662.
Dicopyge ommata, 144.
Didelphis, 244, 247, 251.
  marsupialis caucæ, 200.
  marsupialis etensis, 116, 200, 364.
  marsupialis marsupialis, 562.
  opossum, 563.
  paraguayensis, 589.
  paraguayensis andina, 116, 200.
  paraguayensis meridensis, 200.
  paraguayensis paraguayensis, 562.
  quica, 562, 563.
  virginiana, 497.
Didelphodus absarokæ, 244.
Dimetrodon, 646.
Dinomys branickii, 207.
Diodon hystrix, 173.
Diopeus, 643, 646.
  leptocephalus, 625, 641.
Diplectrum radiale, 163.
  sciurus, 162.
Dirias zaparo, 225.
Dolichoderus attelaboides, 12.
  decollatus, 12.
  (Hypoclinea) bidens, 12.
Dolichotis salinicola, 567.
Dormitator maculatus, 175.
Dorymyrmex pyramicus, 12.
Dredging and hydrographic records of the U. S. Fisheries Steamship 'Albatross' during the voyage to the Gulf of California in 1911, 453–475.
Drymophila **phantatis,** 396.
Dryolestes (Phascolestes), 244.
Dryopithecus, 293, 294, 337.
  chinjiensis, 257, 295.

Dryopithecus darwini, 305.
fontani, 289, 306.
giganteus, 298.
punjabicus, 255, 296.
rhenanus 255, 256, 309.
Dysithamnus affinis, 552.
affinis affinis, 536, **552**, 554.
affinis andrei, 557.
affinis emiliæ, 536, 553, **555**.
affinis spodionotus, 534, 536, **556**.
andrei, 534, 536, **556**, 557.
extremus, 534, 536, **549,** 550.
mentalis, 533, 534, 536, 540, 543, 546, 552, 553, 556.
mentalis **æquatorialis,** 535, **539,** 544.
mentalis andrei, 557.
mentalis **lateralis,** 535, **540,** 544.
mentalis mentalis, 535, **536,** 538, 540, 555.
mentalis oberi, 557, 558.
mentalis olivaceus, 540, 546.
mentalis semicinereus, 540, 546.
mentalis septentrionalis, 536, **542,** 543, 544.
mentalis spodionotus, 556.
mentalis suffusus, 536, 542.
mentalis var. affinis, 552.
mentalis var. olivacea, 552.
mentalis var. semicinerea, 543, 546.
mentalis var. semicinereus, 540.
mentalis var. tambillana, 546.
oberi, 557.
olivaceus, 552, 545.
olivaceus olivaceus, 552.
olivaceus semicinereus, 546.
semicinereus, 534, 536, 540, 542, **545,** 549, 550, 556.
spodionotus, 556.
tambillanus, 546.

ECHIMYS cayenensis, 115.
semispinosus, 115.
Echinocactus diguetii, 430.
Eciton burchelli, 3.
Ectatomma (Gnamptogenys) mordax, 2.
(Gnamptogenys) tortuolosum, 2.
quadridens, 2.
strigosum var. lugens, 2.
tuberculatum, 2.
Edaphosaurus, 647.
pogonias, 637–641.
Eleotris pictus, 175.
Elephant seal, 405–408.
Elops saurus, 452.
Embiotoca jacksoni, 168.
Emblemaria oculocirris, 178.
Emmeekia venustata, 169.
Engraulis mordax, 150.
Eoanthropus dawsoni, 323.
Eodelphis browni 482–491.
Epimys norvegicus, 570.
rattus alexandrinus, 118, 209, 570, 596.
Eptesicus andinus, 199, 226.
chapmani, 583.
Eques viola, 168.
Eremicaster tenebrarius, 431.
Eretmochelys squamata, 445.
Erinaceidæ, primitive relatives of, 244.
Erinaceus, 251.
Eryops, 612, 618.
Etropus crossotus, 181.
Eucinostomus californiensis, 164.
Euloewia ochreicornis, 15.
Eumops milleri, 227.
Euphractus sexcinctus gilvipes, 564, 590.
Eupomacentrus rectifrænum, 168.
Euponera (Mesoponera) constricta, 3.
(Mesoponera) lævigata, 2.
(Trachymesopus) stigma, 3.
Eurystole eriarcha, 156.
Eurythorax sublævis, 127, 128.
Evania **carinata,** 717.
rubrofasciata, 718.
Exerpes asper, 178.
Extinct anthropoids and men of Europe, 301–336.

FAYUM Oligocene anthropoids, 280–285.
Felis æquatorialis, 123.
bracata, 560.
carrikeri, 224.
chibigouazou, 580.
concolor söderströmii, 115.
elegans, 581.
eyra, 224.
geoffroyi, 580.
glaucula, 580, 581.
guttula, 580.

Felis jaguarundi, 224.
    macroura, 580.
    mitis, 581.
    pajeros thomasi, 115.
    paraguensis, 575.
    pardalis, 598.
    pardinoides, 581.
    pardinoides andina, 123, 581.
    pardinoides emerita, 582.
    pardinoides oncilla, 224, 581.
    tigrina, 580.
    wiedi, 580.
Fisheries and fishery resources of Gulf of California, 433–452.
Fistularia depressa, 153.
Fodiator acutus, 153.
Food fishes of Lower California, 447–452.
Food habits, evolution of human, 342–344.
Foot of man and other Primates, 329–333.
Formicarius mentalis, 537.
    olivaceus, 545.
Formicivora rufa **chapmani**, 396.
Formicomyia, 17.
    ovata, 18.
Fraternus, 506.
Frontocnephalia, 16.
    augusta, 16.
Fundulus parvipinnis, 151.
    parvipinnis **brevis**, 150.
Furipterus torrens, 226.

GALEUS dorsalis, 141.
Gastrophilus rhinocerontis, 381.
Gerres lineatus, 165.
    peruvianus, 165.
Gibbons, 272.
    origin of, 338.
Gibbonsia elegans, 178.
Gigantiops destructor, 13.
Gillellus arenicola, 176.
Girella nigricans, 165.
    simplicidens, 165.
Globicephalus scammoni, 430.
Glossophaga **apolinari, 86**, 199, 225.
    soricina microtus, 582.
    soricina soricina, 225.
    soricina valens, 123.
Gnathanodon speciosus, 159, 424, 452.
Gobiesox adustus, 177.
    funebris, 177.
Gobiosoma crescentale, 175.
    histrio, 175.
Gobius saggitula, 175.
Gorilla, 276, 312.
    origin of, 340.
Gouazoupoucou, 565.
Gregory, William K., studies on the evolution of the Primates, 239–355.
Griphopithecus suessi, 309.
Grison furax, 573.
Guerlinguetus æstuans venustus, 199.
    candelensis, 199.
    griseimembra, 199.
    hoffmanni quindianus, 199.
    pucheranii salentensis, 199.
Gymnachirus **melas**, 71.
Gymnopyga, 50, 51.
Gyropleurodus francisci, 141.
Gyrostigma, 381.
    conjungens, 382.
    meruensis, 382.
    pavesii, 382–387.
    rhinocerontis bicornis, 381, 382, 383.
    sumatrensis, 381, 382.

HÆMULON sexfasciatum, 163.
    steindachneri, 163.
Hapale chrysoleucos, 585.
    geoffroyi, 227.
    leucopus, 228.
    melanura, 584, 585.
Hapalidæ, 261, 262.
Haplomylus, 244.
Harpe diplotænia, 169.
Harper, Francis, see Murphy, Robert Cushman.
Hemiderma perspicillatum, 124, 225, 601.
    perspicillatum aztecum, 374.
Hemirhamphus balao, 153.
Hemithraupis flavicollis **aurigularis**, 389.
Henricia clarki, 418.
Hermosilla azurea, 166.
    robustus, 166.
Herpailurus jaguarundi, 224, 579.
Hesperomys albigularis, 115.
    aureus, 115.

Hesperomys bicolor, 115.
  caliginosus, 115.
  latimanus, 115.
  longicaudatus, 115.
  minutus, 115.
Heteromys anomalus, 209.
  australis, 198, 208.
  crassirostris, 370.
  lomitensis, 198, 208.
  zonalis, 370.
Heterozonias alternatus, 432.
Hippasteria californica, 432.
Hippocamelus bisulcus, 565.
Hippocampus ingens, 155.
Hippoglossina macrops, 180.
Hollister, N., shrews collected by the Congo Expedition of the American Museum, 663–680.
Holocanthus passer, 172.
Holochilus amazonicus, 571.
  vulpinus, 571.
Homo dawsoni, 323.
  heidelbergensis, 312, 321.
  neanderthalensis, 255, 323, 336.
  sapiens, 254, 255, 312.
Hoplomys goethalsi, 370.
  gymnurus, 207.
Hoplopagrus güntheri, 163.
Hussakof, L., lungfish remains of the Coal Measures of Ohio, with special reference to the supposed amphibian *Eurythorax* of Cope, 127–133; a new Pycnodont Fish (*Cœlodus syriacus*), from the Cretaceous of Syria, 135–137.
Hydrochœrus hydrochœris, 204, 568, 594.
  isthmius, 371.
Hylobates (Symphalangus) syndactylus, 282.
Hylobatinæ, 282, 283.
Hymenaster perissonotus, 432.
  quadrispinosus, 432.
Hypocnemis **collinsi,** 395.
Hyporhamphus roberti, 152.
  rosæ, 152.
Hypsoblennius gentilis, 178.
Hypsopsetta guttulata, 180.
Hypsypops rubicundus, 169.

Icelinus quadriseriatus, 174.
Inuus, 49.
  erythræus, 50.
Iridio dispilus, 169.
  semicinctus, 169.
Isaciella brevipinnis, 164.
Isothrix darlingi, 370.
  rufodorsalis, 208.

Jacchus leucomerus, 585.
  melanurus, 583.
Jaguarius, 575.
Jenkinsia acuminata, 149.
Jurinia, 21.
  brasiliensis, 20.

Kyphosus analogus, 167.

Labidosaurus, 623.
Labrisomus xanti, 178.
Lagothrix cana, 588, 608.
  lagotricha, 236, 265.
  lugens, 236, 609.
Leng, Charles W., and Mutchler, Charles J., descriptive catalogue of West Indian Cicindelinæ, 681–699.
Leontocebus geoffroyi, 374.
Leptosciurus pucheranii caucensis, 218.
  pucheranii medellinensis, 218.
  pucheranii pucheranii, 218.
  pucheranii salentensis, 199, 218.
Leptychaster inermis, 431.
Lepus alleni tiburonensis, 426.
  andinus, 117.
  californicus xanti, 418, 421.
  daulensis, 113, 118.
  insularis, 430.
Letharchus **pacificus,** 148.
Leuresthes tenuis, 155.
Lithrodes, 417.
  panamensis, 431.
Lophaster furcilliger, 433.
Loxodon africanus, 377.
Lucioblennius alepiodotus, 178.
  lucius, 179.
Lutra sp., 121.
Lutra repanda, 372.
Lutz, Frank E., the geographic distribution of Bombidæ (Hymenoptera), with notes on certain species of Boreal America, 501–521.

Lycalopex vetulus, 575.
Lycodontis funebris, 149.
Lynchailurus pajeros pajeros, 580.
Lyssodes, 51, 52.
Lythrulon flaviguttatum, 164.

MACACA, 49, 51.
Macacus, 49, 50, 52.
  arctoides, 51.
  innominata, 51.
  irus, 51, 52.
  rhesus, 50.
  speciosus, 51.
Macrogeomys dariensis, 369.
Macrojurinia, 20.
Macromeigenia **aurea,** 21.
Magus, 50.
  maurus, 50.
  sylvanus, 50.
Maimon, 50, 51.
Malacoctenus delalandi, 178.
Malimbus **flavipes,** 27.
  gracilirostris, 27.
Man, adaptive characters of, 277.
  origin of, 341, 345–348.
Manospondylus gigas, 761.
Manta birostris, 649–657.
Margay, 580.
  caucensis, 199, 223.
  glaucula, 581.
  guttula, 581.
  tigrina andina, 581.
  tigrina elenæ, 199, 223, 582.
  tigrina emerita, 582.
  tigrina oncilla, 224, 581.
  tigrina wiedi, 223, 580, 598.
  wiedi andina, 123.
Marmosa chapmani, 244, 247.
  constantiæ, 561.
  isthmica, 200, 363.
  mitis, 201.
  mitis pallidiventris, 201.
  murina zeledoni, 200.
  phæa, 200, 201.
Matthew, W. D., association of the Piltdown skull and jaw, 348–350; a Marsupial from the Belly River Cretaceous. With critical observations upon the affinities of the Cretaceous Mammals, 477–500.
Mazama fuscata, 113, 117.
  gualea, 113, 117.
  murelia, 197, 203.
  rufa, 592.
  rufa rufa, 566.
  rufina, 117.
  sartorii reperticia, 365.
  sheila, 204.
  simplicicornis, 566, 592.
  tschudii, 204.
  zamora, 113, 117.
  zetta, 204.
Megacerops **riggsi,** 723.
Melanomys affinis affinis, 198, 214.
  affinis monticolor, 198, 214.
  buenavistæ, 198, 215.
  caliginosus caliginosus, 119.
  caliginosus oroensis, 113, 119.
  idoneus, 369.
  lomitensis, 198, 215.
  obscurior, 215.
  phæopus olivinus, 119.
  phæopus phæopus, 119, 215.
  phæopus tolimensis, 198, 215.
  phæopus vallicola, 198, 215.
Melanopteryx maxwelli. 27.
  nigerrimus, 27.
Menacodon, 241.
Menticirrhus undulatus, 168.
Mesosciurus candalensis, 199, 219.
  gerrardi baudensis, 199, 219.
  gerrardi choco, 365.
  gerrardi milleri, 198, 219.
  gerrardi morulus, 365.
  gerrardi salaquensis, 198, 219.
  gerrardi valdiviæ, 199, 219.
  gerrardi versicolor, 120.
  griseimembra, 199, 219.
  hoffmanni hoffmanni, 120, 218.
  hoffmanni hyporrhodus, 219.
  hoffmanni manavi, 120.
  hoffmanni quindianus, 199, 218.
  saltuensis magdalenæ, 199, 219.
Metachirus fuscogriseus fuscogriseus, 363.
  nudicaudatus, 562.
  nudicaudatus **antioquiæ, 83,** 197, 202.
  nudicaudatus columbianus, 83, 201.
  nudicaudatus dentaneus, 83, 364.

Metachirus opossum griscescens, 201.
  opossum melanurus, 116, 201.
  opossum quica, 562, 589.
  opossum subsp., 201.
Microchœridæ, 263.
Microgymnomma, 18.
  orbitalis, 18.
Micronycteris megalotis megalotis, 225.
Microsciurus alfari venustulus, 366.
  florenciæ, 198, 218.
  isthmius vivatus, 366.
  mimulus, 218.
  otinus, 217.
  palmeri, 218.
  similis fusculus, 217.
  similis similis, 217.
Microxus affinis, 198, 216.
  bogotensis, 216.
  bennetti, 599.
Mobula olfersi, 649–657.
Molar, human, from Trinil, Java, 257.
  patterns of in Primates, 252.
Molossops bondæ, 227.
  cherriei, 529, 583.
  daulensis, 530.
  obscurus, 583, 602.
  pygmæus, 125, 530.
  temmincki, 583, 601.
Monomorium pharaonis, 8.
Mormon bennetti, 582.
Mugil cephalus, 450.
  curema, 158, 450.
Murphy, Robert Cushman, notes on American Subantarctic cormorants, 31–48;
Murphy, Robert Cushman, and Harper, Francis, two new diving petrels, 65–67.
Mus musculus musculus, 209.
Mustela affinis, 90, 98, 100, 101, 220.
  affinis affinis, 100, 101, 107, 109, 110, 111, 220.
  agilis, 90, 104.
  auriventer, 90.
  aureoventris, 90, 101, 220.
  brasiliensis, 91, 101.
  costaricensis, 91, 101.
  frenata, 91.
  gulina, 572.
  jelskii, 90, 102.
Mustela macrura, 90, 101, 102, 111.
  meridana, 91, 100.
  paraensis, 90, 105, 108, 111.
  sinuensis, 91.
  stolzmanni, 90, 105.
  tropicalis, 90, 91–98.
  tropicalis **nicaraguæ, 100,** 106, 108, 111.
  tropicalis perdus, 91.
  tropicalis tropicalis, 99, 106, 108, 111.
Mutchler, Andrew J., see Leng, Charles W.
Mycetes chrysuros, 229.
  laniger, 230.
  seniculus, 232.
  ursinus, 232.
Mycteroperca jordani, 451.
  pardalis, 162, 424, 452.
  rosacea, 162.
  venadorum, 162, 426, 452.
Myiopagis viridicata **rondoni,** 188.
Myiothera poliocephala, 536.
Myliobatis californicus, 145.
Myoprocta exilis milleri, 198, 205.
  pratti, 205.
Myospiza manimbe **nigrostriata,** 189.
Myothera mentalis, 536.
Myotis caucensis, 199, 227.
  chiriquensis, 373.
  esmeraldæ, 113, 124, 227.
  punensis, 113, 124, 227.
Myrichthys tigrinus, 147.
Myrmecophaga bivittata straminea, 560.
  sellata, 560.
  tridactyla, 117, 563, 590.
Myrmotherula **kermiti,** 184.
Myrmophis vafer, 146.
Myxodagnus opercularis, 177.

Narcine entemedor, 144.
Nasalis larvatus, 265.
Nasua judex, 221.
  narica panamensis, 372.
  nasua candace, 221.
  nasua manium, 121.
  nasua quichua, 122.
  nasua solitaria, 573, 597.
  nasua olivacea lagunetæ, 199, 222.

Nasua olivacea quitensis, 115, 122.
  quichua, 221.
  quichua jivaro, 122.
  sociabilis, 574.
  solitaria, 574.
Neacomys amænus, 561.
  pictus, 369.
  pusillus, 198, 211.
  spinosus, 212.
  spinosus amœnus, 570, 596.
Nearchaster aciculosus, 432.
Neanderthal man, 323–336.
Necrolemus, 263.
  antiquus, 263, 264.
Nectomys alfari efficax, 369.
  garleppei, 217.
  magdalenæ, 217.
  squamipes, 571, 597.
  squamipes mattensis, 561.
Nematistius pectoralis, 158, 451.
Nemestrinus, 51, 52.
Neocebus, 52.
Neocuterebra squamosa, 377, 379.
Neomænis argentiventris, 163, 451.
  colorado, 163.
  guttatus, 452.
  novemfasciatus, 163.
Neopithecus, 52, 310, 338.
  brancoi, 310.
Neoponera apicalis, 2.
  carinulata, 2.
  commutata, 2.
  obscuricornis, 2.
  unidentata, 2.
  villosa subsp. inversa, 2.
Neotoma albigula seri, 426.
  insularis, 426.
  intermedia arenacea, 418.
  intermedia gilva, 413.
  intermedia pretiosa, 417.
Nesophontes edithæ, 725–728.
Nesophontidæ, 728.
Netuma platypogon, 146.
Nichols, John Treadwell, on a new race of minnow from the Rocky Mountains Park, 69; a new *Gymnachirus* from North Carolina, 71. See also Osburn, Raymond C.
Nightjar, Pennant-winged, 73–81.
Notharctus, 242.
  formosus, 262.
Nyctinomus æquatorialis, 113, 125.
Nyctipithecus lemurinus, 234.

OCYPTERA simillima, 22.
Odocoileus hemionus peninsulæ, 413.
Odontomachus chelifer, 3.
  hæmatoda, 3.
  hastatus, 3.
Œcomys bicolor, 119, 210, 524.
  emilæ, 525.
  florenciæ, 524.
  milleri, 523, 570.
Œdipomidas geoffroyi, 227.
  leucopus, 228.
  œdipus, 228.
  salaquiensis, 227.
Œstrus rhinocerontis, 380, 381.
Ogilbia ventralis, 180.
Oligoplites mundus, 159.
  saurus, 159.
Oligoryzomys, 526.
  costaricensis, 368.
Omomys sp., 244, 253, 263.
Oncoides pardalis æquatorialis, 123, 222.
  pardalis chibigouazou, 580, 598.
  pardalis mearnsi, 371.
Ophiacodon, 645.
Ophichthus triserialis, 149.
Ophisthonema libertate, 150.
Orang-utan, 274.
  origin of, 339.
Ornitholestes, 733, 736.
  hermanni, **735–738.**
Ornithomimus, **733,** 737, 741, **743, 744,** 751, 754, 755.
  grandis, 740.
  velox, 738–741.
Oryzomys alfaroi dariensis, 368.
  angouya, 570, 596.
  arenalis, 527.
  aureus, 118.
  auriventer, 118, 213.
  balneator, 213.
  barbacoas, 85, 198, 213.
  costaricensis, 526.
  dryas, 119.
  dryas humilior, 526.

Oryzomys frontalis, 369.
  fulvescens, 526.
  gracilis, 213.
  griseola, 527.
  helvolus, 198, 212.
  incertus, 198.
  laticeps, 570.
  longicaudatus, 118.
  (Melanomys) obscurior, 214.
  (Melanomys) obscurior affinis, 198, 214.
  (Melanomys) phæopus, 215.
  mureliæ, 198, 213.
  nitidus, 119.
  o'connelli, 198, 212.
  palmiræ, 198, 213.
  pectoralis, 198, 212.
  perenensis, 213.
  pirrensis, 368.
  sp., 570, 571.
  (Oligoryzomys) fulvirostris, 198,214.
  (Oligoryzomys) **mattogrossæ, 528,** 571, 597.
  (Oligoryzomys) **microtus, 525,** 571.
  (Oligoryzomys) munchiquensis, 198, 214, 527.
  (Oligoryzomys) navus, 527.
  (Oligoryzomys) nicaraguæ, 526.
  (Oligoryzomys) stolzmanni, 119.
  (Oligoryzomys) tenuipes, 214.
  (Oligoryzomys) **utiaritensis, 527,** 571.
  (Oligoryzomys) vegetus, 526.
  talamancæ, 369.
  tenuipes, 527.
  vicencianus, 198, 212.
Osborn, Henry Fairfield, two new Oligocene Titanotheres, 721–723; skeletal adaptations of *Ornitholestes*, *Struthiomimus*, *Tyrannosaurus*, 733–771.
Osburn, Raymond C., and Nichols, John Treadwell, shore fishes collected by the 'Albatross' Expedition in Lower California, with descriptions of new species, 139–181.
Ostrea virginica, 447.
Otophidium galeoides, 179.
Ouanderou, 50.
Ovoides setosus, 173.
Oxyjulis californicus, 169.
Oxymcterus rufus, 572.

PACHYCONDYLA crassinoda, 2.
Pachycormus discolor, 411, 414.
Pachynathus capistratus, 173.
Palæopithecus, 338.
  sivalensis, 255, 299.
Palæosimia, 336.
  rugosidens, 286.
Palæosyops leidyi, 245.
Paludipasser **uelensis,** 24.
Panthera onca, 222, 578.
Pan, 312.
  (Anthropopithecus) sp., 255.
  vellerosus, 268, 270.
  vetus, 312, 313.
Panthera onca centralis, 371.
  paragayensis, 578.
  paraguensis, 575, 578.
Panulirus, 413.
  interruptus, 444.
Paralabrax clathratus, 162.
  maculatofasciatus, 162.
  nebulifer, 162.
Paralichthys californicus, 180.
Parapithecidæ, 282, 283.
Parapithecus, 280, 294, 336.
  fraasi, 282.
Paraponera clavata, 2.
Pariasaurus, 633.
Pearl fishery of Gulf of California, 433–434.
  oyster cultivation, Gulf of California, 434–444.
Pecari, 564.
  crusnigrum, 203, 364.
  niger, 113, 117.
  tajacu, 564, 565, 591.
Pectinaster agassizii, 432.
Pelecanoides **georgica,** 66.
  urinatrix **chathamensis,** 65.
  urinatrix urinatrix, 66.
Pelycodus ralstoni, 263.
  trigonodus, 240, 253, 254.
Peralestes, 244.
Peramys, 563, 589.
Peribolaster biserialis, 433.
Perkinsia othonops, 149.

Perognathus baileyi insularis, 426.
  fallax, 413.
  penicillatus arenarius, 413.
  penicillatus seri, 426.
  rhydinorhis, 421.
  siccus, 418.
  spinatus occultus, 424.
  spinatus peninsulæ, 418, 421.
Peromyscus eremicus carmeni, 424.
  eremicus cedroscensis, 409, 411.
  eremicus eva, 418, 421.
  eremicus polypolius, 417.
  guardia, 426.
  maniculatus coolidgi, 413.
  (Megadontomys) pirrensis, 366.
  stephani, 428.
Petrels, burrows of, East San Benito Island, 410.
Petrometopon panamensis, 160.
Phacellodomus ruber **rubicula,** 186.
Phalacrocorax albiventer, 32, 33.
  atriceps, 31, 33, 39.
  atriceps georgianus, 34–48.
Phania simillima, 32.
Pheidole biconstricta, 5.
  cataractæ, 6.
  cramptoni, 4.
  exigua, 5.
  jelskii, 5.
  mimula, 5.
Philander laniger cicus, 202.
Philydor erythrocercus **lyra,** 186.
Philypnus lateralis, 175.
Phyllostomus hastatus caucæ, 225.
  hastatus panamensis, 225, 373.
Phyllotis haggardi, 120.
Phylogeny, Hominidæ and Simiidæ, 336.
Piaya rutila **chaparensis,** 392, 394.
  rutila gracilis, 394.
  rutila **orinocensis, 393,** 394.
  rutila panamensis, 394.
  rutila rutila, 393.
Picolaptes angustirostris **prædatus,** 187.
Piltdown man, 313–320.
  association of remains, 348–350.
Pimelometopon pulcher, 169, 452.
Pithecanthropus erectus, 320, 338.
Pithecia milleri, 233.
  monachus, 125.
Pithecia pithecia, 233.
Pithecus, 49, 50, 52.
  albibarbatus, 50.
Pithes sylvanus, 50.
Pithex, 50.
  oinops, 50.
Platophys leopardinus, 180.
Pleuronichthys verticalis, 180.
Pliopithecus, 294, 336.
  antiquus, 254, 282, 301.
Pomadasis macracanthus, 452.
Ponera opaciceps, 3.
Porichthys notatus, 177.
Potos flavus, 574.
  flavus caucensis, 222.
  flavus chiriquensis, 372.
  flavus meridensis, 222.
  flavus modestus, 122.
  flavus tolimensis, 199, 222.
Premolar analogy theory, 241, 242, 243.
Prenolepis (Nylanderia) cæciliæ, 13.
  (Nylanderia) lietzi, 13.
  (Nylanderia) longicornis, 13.
Primates, classifications of, 266.
Priodontes giganteus, 564.
Prionace glauca, 141.
Procyon æquatorialis, 113.
  cancrivorus brasiliensis, 573.
  (Euprocyon) æquatorialis, 121.
  (Euprocyon) cancrivorus nigripes, 573.
  nigripes, 573.
Proechimys **boimensis,** 523.
  centralis panamensis, 370.
  kermiti, 569, 596.
  longicaudatus, 569, 596.
  o'connelli, 198, 207.
  semispinosus calidior, 118, 207.
  semispinosus semispinosus, 206.
Promicrops guttatus, 450.
Promops fosteri, 125.
Propithecus coquerelli, 264.
Propliopithecus, 284, 294, 336.
  hæckeli, 282.
Prosaurolophus maximus, 701, 702, 704.
Proscalops secundus, 244.
Protocone, origin of, 246.
  defined, 250.

Pseudalopex culpæus reissii, 122.
sechuræ, 122.
Pseudarchaster pusillus, 413.
Pseudogametes, 378.
Pseudohystricia, 21.
Pseudomyrma gracilis, 3.
gracilis var. dimidiata, 3.
nigrocincta, 3.
Psilaster pectinatus, 432.
Psithyridæ, 502.
Pteraster jordani, 433.
Pteroplatea marmorata, 145.
Puma pearsoni, 579.
puma concolor, 579.
Putorius affinis, 101.
brasiliensis var. æquatorialis, 90, 102.
macrophoneus, 92.
macrurus, 101, 220.
(Mustela) brasiliensis paraensis, 105.
paraensis, 105.
tropicalis, 99.
tropicalis perdus, 99.

Quassiremus notochir, 147.

Raja **microtrachys,** 142.
Reithrodontomys milleri, 198, 209.
söderströmi, 209.
Rhesus, 50, 51, 52.
Rhinichthys cataractæ **smithi,** 69.
Rhinobatis productus, 142.
Rhinoceros (Ceratotherium) simus cottoni, 380.
Rhipidomys, 570.
caucensis, 198, 210.
cocalensis, 198, 210.
goodfellowi, 210.
mollissimus, 198, 210.
quindianus, 198, 210.
roberti, 561.
similis, 198, 210.
Rhizodus quadratus, 131.
Rhopoterpe torquata **tragicus,** 184.
Rhynchiscus naso, 224, 582, 599.
Rogenhofera, 378.
Runula azalea, 178.
Rypticus xanti, 163.

Saccopteryx bilineata, 123, 373, 582, 599.
Sagenodus, 127, 132, 133.
fossatus, 131.
ohiensis, 130.
serratus, 132.
sublævis, 129.
Saimiri **caquetensis, 87,** 199, 234.
cassaquiarensis, 586, 605.
ustus, 586, 605.
Salmacis, 50.
Sardinella stolifera, 150.
thrissina, 149.
Saurolophus osborni, 703, 705.
Sauromalus hispidus, 426.
Schizaster latifrons, 431.
townsendi, 433.
Sciurus gerrardi salaquensis, 198.
hoffmanni manavi, 113.
hoffmanni söderströmi, 116.
igniventris zamoræ, 113.
langsdorffi urucumus, 572.
milleri, 198.
saltuensis magdalenæ, 199.
stramineus zarumæ, 113.
Scomber colias, 450.
Scomberomorus maculatus, 450.
sierra, 158.
Scorpæna guttata, 174.
mystes, 174.
sonoræ, 174.
Scutisorex congicus, 673, 680.
Sebastopsis xyris, 174.
Selene vomer, 159.
Seniocebus meticulosus, 228.
Sericomyrmex aztecus, 11.
burchelli, 10.
diego, 11.
lutzi, 9.
mayri, 10.
opacus, 11.
parvulus, 11.
saussurei, 11.
scrobifer, 11.
urichi, 11.
Seriola dorsalis, 159, 417, 452.
Seriphus politus, 168.
Serranus maculato-fasciatus, 451.
Seymouria, 618, 632.

Sigmodon borucæ chiriquensis, 368.
  chonensis, 113, 120.
Silenus, 50, 51, 52.
  albibarbatus, 51.
Simia, 49, 50.
  argentata, 584.
  (Cercopithecus) silenus albibarbatus, 50.
  inuus, 49.
  nemestrinus, 51.
  rhesus, 50, 51.
  seniculus, 228.
  silenus, 50, 51.
  sinica, 50, 51.
  sphinx, 51.
  sylvanus, 49, 50.
  ursina, 232.
  veter, 50.
Simosciurus stramineus zarumæ, 121.
Siphostoma carinatum, 153.
  exile, 153.
  leptorhynchum, 153.
Sivapithecus, 336.
  indicus, 255, 287, 312.
Siwalik Upper Miocene and Lower Pliocene Anthropoids, 285–301.
Solaster borealis, 432.
  paxillatus, 433.
Solenopsis brevicornis, 3.
  geminata, 3.
  geminata subsp. sævissima, 3.
Spalacotherium, 241.
Spathicera, 381.
  meruensis, 381.
  pavesii, 381.
Sphæroides annulatus, 173.
  lobatus, 173.
Sphagebranchus selachops, 146.
Sphingurus sericeus, 560.
Sphyræna argentea, 158, 421, 451.
Sporophila hypoleuca **clara,** 188.
Stentor chrysuros, 230.
  ursinus, 232.
Stereolepis gigas, 413.
Stilbopsar **leucothorax,** 23.
Stomachomyia, 382.
Strongylocentrotus fragilis, 432.
Struthiomimus, 733, 736, 737, 743, **744,** 753–761, 765.
Struthiomimus, altus, 741, 742, 743, **744–752.**
  tenuis, 740, 741.
Sturnira lilium, 124.
Sus albirostris, 565.
  labiatus, 565.
  tajacu, 564, 565.
  tajassu, 564.
Syacium ovale, 180.
Sylvanus, 49.
Sylvilagus **boylei, 84,** 198, 204.
  fuscescens, 204.
  gabbi gabbi, 371.
  gabbi messorius, 371.
  minensis chapadæ, 561.
  paraguensis, 567, 593.
  salentus, 204.
  (Tapeti) fulvescens, 197.
  (Tapeti) fuscescens, 204.
  (Tapeti) salentus, 198, 204.
Sylvisorex gemmeus irene, 671.
  oriundus, 672, 676, 678.
Symphalangus syndactylus, 268, 270.
Symphurus atricaudus, 181.
  fasciolaris, 181.
  williamsi, 181.
Synallaxis **rufogularis,** 185.
Synodus lacertinus, 150.

TACHINA obesa, 21.
Tamandua tetradactyla chiriquensis, 203, 364.
  punensis, 83, 113, 117.
Tapirella bairdi, 365.
Tapirus terrestris, 566, 592.
  terrestris **guianæ,** 565.
Taraba major **virgultorum,** 39.
Tatusia megalolepis, 560.
Tayassu, 564.
  pecari, 365, 564.
  pecari pecari, 564.
Tayra barbara barbara, 221.
  barbara biologiæ, 372.
  barbara gulina, 572, 597.
  barbara irara, 121.
  barbara madeirensis, 115.
  barbara senilis, 113, 121.
  barbara tucumana, 115.
Telmatherium, 251.

Tetracha, 684.
Tetracha acutipennis, 684, 685.
  carolina, 684, 686.
  carolina **floridana**, 688.
  carolina var. occidentalis, 687.
  sobrina, 684, 685.
  sobrina var. **antiguana**, 686.
  sobrina var. **infuscata, 686,** 691.
Thamnophilus mentalis, 545.
  olivaceus, 534, 545.
  (Silvestrius) flavescens, 537.
Theory of trituberculy, application of to the molar patterns of Primates, 252–257.
Theropleura, 625, 634, 643.
Thlæodon padanicus, 492, 499.
Thomasomys aureus altorum, 113, 119.
  aureus aureus, 119.
  cinereiventer, 198, 211.
  laniger, 210.
  paramorum, 119.
  popayanus, 198, 211.
  rhoadsi, 116.
Thraupis palmarum **duvida,** 190.
Thrinacodus apolinari, 198, 208.
Thrissacanthus penicillatus, 432.
Thylamys caucæ, 201.
Todd, W. E. Clyde, on *Dysithamnus mentalis* and its allies, 533–560.
Townsend, Charles Haskins, voyage of the 'Albatross' to the Gulf of California in 1911, 399–476.
Townsend, Charles H. T., new an[illegible]oteworthy Brazilian Muscoidea [illegible]lected by Herbert H. Smith, 15–22.
Trachinotus palomo, 160.
  rhodopus, 160.
Trachurops crumenopthalmus, 159, 450.
Trachurus symmetericus, 159.
Trachymyrmex farinosa, 11.
  urichi subsp. fuscus, 11.
Triakis semifasciatum, 141.
Tricentes, 244.
Trimerorachis, 631.
Tursiops gilli, 413.
  nuuanu, 430.
Tylomys **fulviventer,** 366.
  miræ, 217.
Tylosurus fodiator, 152.
  pterurus, 152, 154.
Tyrannosaurus, 761.
Tyrannosaurus rex, 762–771.
Ulvicola sanctæ-rosæ, 179.
Umbrina roncador, 168.
  xanti, 168, 452.
Upeneus xanthogrammus, 158.
Uramya producta, 15.
Urechinus reticulatus, 432.
Urobatis **concentricus,** 144.
Uroderma bilobatum, 124, 226, 373.
Uropterygius necturus, 149.
Urosciurus igniventris igniventris, 219.
  igniventris tœdifer, 220.
  igniventris zamora, 120.
  langsdorffii urucumus, 572.
  pyrrhonotus pyrrhonotus, 572.
Urotrygon mundus, 145.

Vampyrops dorsalis, 226.
  lineatus, 582, 599.
Venefica tentaculata, 417.
Vetulus, 51, 52.
Viereck, Henry L., new species of the bee genus *Andrena* in the American Museum of Natural History, 729–732.
Viscaccia cuscus, 567.

Wasmannia auropunctata, 8.
  subpolita, 8.
Watson, D. M. S., on the structure of the brain-case in certain Lower Permian Tetrapods, 611–636; reconstructions of the skulls of three Pelycosaurs in the American Museum of Natural History, 637–648.
Wheeler, William Morton, Ants collected in British Guiana by the Expedition of the American Museum of Natural History during 1911, 1–14.
Wortman, classification of Primates, 260.

Xanthozona melanopyga, 20.
Xenistius californiensis, 163.
Xesurus punctatus, 172.
Xiphicolaptes major **saturatus,** 187.
Xiphorhynchus guttata **rimarum,** 391.
Xystæma cinereum, 165, 452.

Zalophus californianus, 409, 449.
Zalypnus emblematicus, 175.
Zati, 51, 52.
  sinicus, 51.

(*Continued from 4th page of cover.*)

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